Collin Technologies Case Study

Malcolm Baldrige National Quality Award

Collin Technologies: A Small Business Case Study

All Malcolm Baldrige National Quality Award applicants need to respond to the Criteria for Performance Excellence in the context of their business and its key business/school factors (KFs). For small businesses, one of their most important KFs is the size of the organization. Baldrige Examiners are trained not to place the operational and procedural requirements of a large enterprise on a small business. The size of a business does not affect the appropriateness of the Criteria, but it does need to be factored into the assessment and into an applicant's response to the Criteria. Some examples are given below to understand the context for response by and review of a small business.

- Corporate citizenship must be viewed in the context of an applicant's size. Large businesses might have impacts on a national basis; small businesses will frequently focus their corporate involvement to a more local community.
- While large corporations frequently have complex computer/information systems for data management, small businesses (depending upon how small) may perform data and information management with a combination of manual methods and personal computer or workstation-based data management systems.
- Benchmarking and competitive comparison information in a small business environment, with limited staff availability, may be based largely on literature/trade association information and comparisons with best practices in the local geographic area.
- In a small business environment, systems for employee involvement and business process management may rely heavily upon informal verbal communication and much less on formal written communication/documentation. However, all applicants have the same burden of demonstrating that processes are fully and systematically deployed throughout their organizations.
- The ability of small businesses to leverage key suppliers, particularly large company suppliers, has to be viewed in the context of staff availability and the volume of business that the applicant organization does with a supplier.
- The ability of some small businesses to obtain customer and market knowledge through independent third-party surveys, commissioned studies, extensive interviews, or focus group techniques is limited by their resources. The important consideration is whether an applicant, given its resources, is using appropriate mechanisms to gather information and whether the applicant is utilizing that information to improve customer focus and satisfaction.

It is important to remember that small business applicants for the Malcolm Baldrige National Quality Award are defined as those with 500 or fewer full-time employees. Even within this category, there is a very significant difference in resource availability between a 450-person organization and a 50-person organization.

This case study was written as a training case for Baldrige Examiners. Some of Collin Technologies' practices exceed those of a typical (or even role model) small business. For example, Collin Technologies' computer network and preferred supplier relationships are not common to a small business environment. These attributes enhance the training value of the case study, but should not be interpreted as an expectation of small business Baldrige applicants or Award recipients.

Collin Technologies Case Study

The Collin Technologies Case Study was prepared for use in the 1999 Malcolm Baldrige National Quality Award Examiner Preparation Course. There may be areas in the case study where Criteria requirements are not addressed. These gaps are intentional and are intended for educational use and appreciation of the possible content of an actual Baldrige Award application.

The Collin Technologies Case Study describes a fictitious company. There is no connection between the Collin Technologies Case Study and any company, either named Collin Technologies or otherwise. Other organizations cited in the case study (customers, suppliers, etc.) are also fictitious. To learn about successful quality practices based on real companies, you can attend *Quest for Excellence*, the official conference of the Malcolm Baldrige National Quality Award.

Malcolm Baldrige National Quality Award

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1 Applicant

Official Name: Collin Technologies

Other Name:

Prior Name:

Headquarters Address: 624 Industrial Court

Nashville, TN 37217

Has the applicant officially or legally existed for at least one year? (Check one.) ✓ Yes ___ No (Briefly explain.)

Attach a line and box organization chart for the applying organization, including the name of the head of each unit or division.

2 For-Profit/Not-For-Profit Designation

The applicant is a for-profit organization ✓; a not-for-profit organization_____. (Check one.)

3 Industrial Classification

List up to three of the most descriptive three- or four-digit NAICS codes. (See page 18.)

3344 _____ _____

4 Award Category (Check one.)

___ Manufacturing ___ Service ✓ Small Business
___ Education ___ Health Care

Criteria being used (check one):
✓ Business ___ Education ___ Health Care

5 Size and Location of Applicant

a. Preceding fiscal year: (Sales) Revenues Budgets
(Circle one and indicate amount below)

___ 0-$1M ___ $10M-$100M ✓ $500M-$1B
___ $1M-$10M ___ $100M-$500M ___ Over $1B

b. Number of sites in: U.S./Territories 1 Overseas 1

c. Total number of employees 390

d. Percent employees in the U.S. and/or territories 70

e. Percent physical assets in U.S. and/or territories 60

f.. If some activities are performed outside the applicant's organization (e.g., by an overseas component of the applicant, the parent organization, or its other subunits), will the applicant, if selected for a site visit, make available in the United States sufficient personnel, documentation, and facilities to allow full examination of its operational practices associated with all major functions of its worldwide operations?
✓ Yes ___ No

g. In the event the applicant receives an Award, can the applicant make available sufficient personnel and documentation to share its practices at the Quest for Excellence Conference and at its U.S. facilities?
✓ Yes ___ No

OMB Clearance #0693-0006
Expiration Date: June 30, 1999

This form may be copied and attached to, or bound with, other application materials.

6 Site Listing and Descriptors

a. Address of Site	b. Size of Site		c. Description of Products or Services
	Number of Employees	**Percent** of (Sales,) Revenues or Budgets (circle one)	
Collin Technologies 624 Industrial Court Nashville, TN 37217	270	65	multilayer printed circuit boards, design center, prototype center, warranty repair center, manufacturing hub, customer service center, company headquarters.
Collin Technologies Building 3K 1010 Koga National Highway Koga, Japan 656-0072	120	35	manufacturing center, warranty repair center, customer service center.

Provide all the information for each site, except where multiple sites produce similar products or services. For such multiple site cases, see page 9.

Use as many copies of this page as necessary to cover all sites.

7 Business/School Factors

Provide a brief description of the following key factors:

a. Nature of applicant's products, services, and technologies; conclude with a list of ***key*** competitors.

Collin's Core Values center around adding value to and pursuing the benefits offered by:
- All of its customer segments;
- All of its employee/owners (EOs);
- All of its suppliers, both product and service providers;
- All of its business reinvestment strategies to maintain industry leadership; and
- All of its business, professional, and civic communities.

Collin designs and manufactures multilayer printed circuit boards with concentration on advanced materials for very high frequencies and more demanding environments with fine lines and spacing for high densities. During recent years, Collin's technology has moved toward two key areas: (1) surface mounted parts with many types of integrated circuit chips; and (2) Collin's proprietary Chemically Bonded Deposition Process (CBDP).

Collin captures maximum advantage from its automated processes by managing technology to accommodate advances, including suppliers and customers in design cycles, and providing EOs the expertise they need before they need it.

Collin maintains a leadership position in its markets by creating a work environment which successfully integrates automation with people. By developing an effective and comprehensive information system and a well-trained and empowered work force, Collin has been able to achieve high levels of product reliability and very short cycle times. These capabilities have enabled the company to satisfy its customers and penetrate key markets.

Four of Collin's major competitors over the past ten years have either quit the business or joined with other manufacturers. Consolidations have had a positive effect on the integrity of the industry, and Collin has become the model for organization, operations, and achieving product and service improvements. Remaining key competitors include:
- KTFL;
- Ace Circuits;
- Ridgeford Technology; and
- Worldwide Corporation.

b. Nature of major markets (local, regional, national, and international); conclude with a list of ***key*** customers/users.

In order to promote the Core Values, Collin must understand each niche in the $6 billion market for multilayer, high performance printed circuit boards and become a key player in the markets that can best use its products. Collin believes that its market represents four key areas:

Government, where defense, national security, deep space exploration, and foreign government interests are looking for small quantities of highly reliable products to satisfy their specific needs.

Industrial Products, where conventional, reliable printed circuit boards are used in manufacturing processes for process control.

Commercial, which comprises both a substantial and stable portion of the market, where Collin's boards are incorporated into products that are manufactured and sold. Commercial customers are very interactive because they seek innovative technologies to include in new products.

Advanced Technology, which comprises a combination of the above for customers seeking new innovations and futuristic applications.

In addition to on-time delivery, competitive prices, and state-of-the-art performance, there are several other aspects that are significant to customers. These include dimensional precision and stability, and extremely high tolerances. These requirements are equally important in a craft conducting exploration in outer space (navigation and communications components), an automobile traveling down a highway (microprocessor manufacturer), or integration of multiple layers and surface mounted parts on a printed circuit board (systems integrator).

Key customers for each business segment include:
- **Government**: The Federal Space Council, the Department for National Security Matters, and the Defense Agency.
- **Industrial Products**: Kelsey Automated Tools, Nippon Industrial Controls, and O'Donnell Do-It-All Machines.
- **Commercial**: My-Toy Appliances, Automobile Microprocessors, and Workplace Comfort Controls.
- **Advanced Technology**: Wormhole Specialties, Practical Futuristic Solutions, and Koga Microprocessor Products.

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7 Business/School Factors (Continued)

c. Importance of suppliers, dealers, distributors, and franchises; conclude with a list of ***key*** suppliers, including the organization's financial auditor.

Since 1992, Collin has strategically increased its supplier base from 75 to 96. There are two company goals that affect the supplier base: first, Collin wishes to maintain a base of no more than 100 suppliers, and secondly, it intends to migrate to a system of 100% preferred suppliers. Preferred suppliers are those with which Collin shares 100% Electronic Data Interchange (EDI) connectivity and offers full participant roles to its Integrated Product Development Teams (IPDTs). In return, preferred suppliers provide Collin with comparative data and information on benchmark processes. This sharing of performance data benefits both Collin and its supplier base. Presently, 50% of Collin's suppliers are preferred suppliers. Preferred supplier relationships allow Collin to eliminate incoming inspections, thereby reducing production lead times.

Among Collin's 48 preferred suppliers, those from whom it purchases the most include:

- Apex Glass Works;
- Supercharged Chips;
- Mica Warehouse; and
- Tron Ltd.

Collin's preferred service providers include land and air carrier services, systems integrators, telecommunications providers, and work force service support. Based upon input from its EOs, Collin has established a training and survey partnership with Interskill.

Collin uses a network of sales coordinators to market products, provide service advice, assess future market needs, act as cultural ambassadors, and seek new customers. The creation of dedicated international sales coordinators was a direct response to a 1992 Malcolm Baldrige National Quality Award feedback report comment. Although they are based in Nashville and Koga, international sales coordinators are recruited from the geographic region they serve to ensure familiarity with local languages and customs.

8 Subunits

Is the applicant a subsidiary, unit, division, or like organization of a larger parent?
(Check one.)
___ Yes (Continue) ✔ No (Go to Item 9.)

a. Parent Organization

Name _____

Address _____

_____

_____

Highest Official _____

Title _____

Number of worldwide employees of the parent _____

b. **Business Only:** Does the applicant have more than 500 employees?
(Check one.) ___Yes ___No

c. **Business Only:** Does the applicant comprise over 25 percent of the worldwide employees of the parent?
(Check one.) ___Yes ___No

d. **Business Only:** Was the applicant independent prior to being acquired, and does it continue to operate independently under its own identity?
(Check one.) ___Yes ___No

e. Does the applicant's parent or another subunit of the parent intend to apply?
(Check one.)
___Yes (Briefly explain.) ___No ___Do not know

8 Subunits (Continued)

f. **Business Only:** Are over 50 percent of the applicant's products or services sold or provided to customers/users outside the applicant's organization, its parent company, and other companies with financial or organizational control of the applicant or parent?

(Check one.) ___Yes ___No (Briefly explain.)

g. Name the document supporting the subunit designation.

_____

_____

Include a copy of the document with this form.

h. Briefly describe the organizational structure and management links to the parent.

Attach line and box organization chart(s) showing the relationship of the applicant to the highest management level of the parent, including all intervening levels.

i. Do other units within the parent provide similar products or services?

(Check one.) ___Yes (Briefly explain.) ___No

If "Yes", also explain how the applicant is distinguishable from the parent and its other subunits.

j. Briefly describe the major support functions provided to the applicant by the parent or by other subunits of the parent.

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9 Supplemental Sections

Does the applicant have: (a) a single performance system that supports all of its product and/or service lines; and (b) products or services that are essentially similar in terms of customers/users, technology, types of employees, and planning?

(Check one.)

✓ Yes (Go to Item 10.)

___ No (Briefly describe the differences in the products and/or services covered in terms of differences in customers, technology, types of employees, and planning. The Eligibility Contact Point will be contacted.)

10 Eligibility Contact Point

Name (Mr. Mrs. (Ms.) Dr.) Michelle Blanton

Title: Director, Continuous Process Improvement

Applicant Name: Collin Technologies

Mailing Address: 624 Industrial Court

Nashville, TN 37217

Overnight Mailing Address: (same as above)

Telephone No.: (615) 555-4110

Fax No.: (615) 555-4115

11 Signature, Highest-Ranking Official

Date 2/23/99

X Candice Trobaugh

Name (Mr. Mrs. Ms. (Dr.)) Candice Trobaugh, Ph.D.

Title: Chief Executive Officer

Applicant Name: Collin Technologies

Address: 624 Industrial Court

Nashville, TN 37217

Telephone No.: (615) 555-4110

Fax No.: (615) 555-4115

DO NOT WRITE BELOW THIS LINE

1999 Eligibility Determination

☐ Manufacturing ☐ Education

☐ Service ☐ Health Care

☒ Small Business

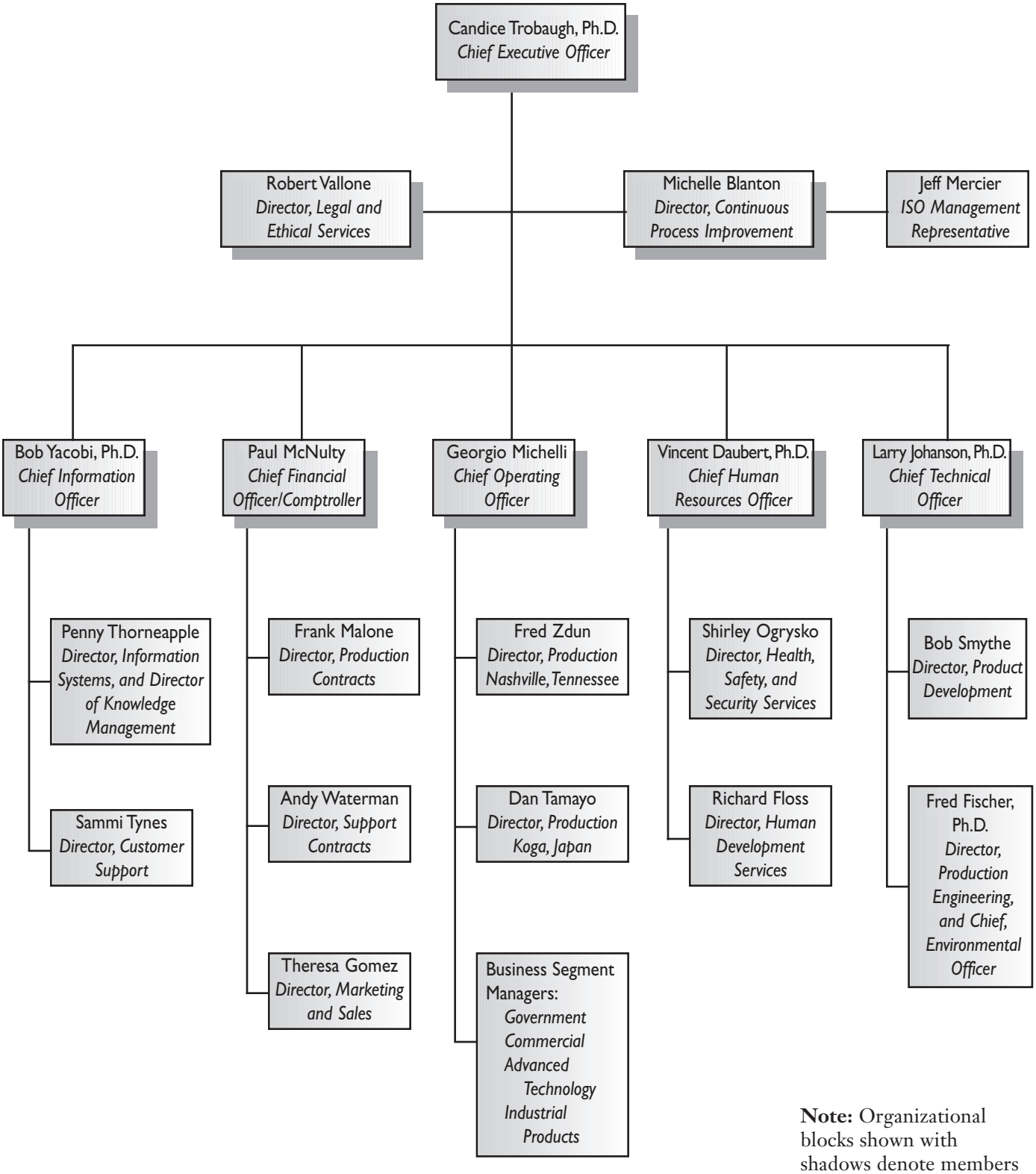
☐ Ineligible

Eligible
3/17/99

Award Administration

For Official Use Only

Collin Technologies Organization Chart



Note: Organizational blocks shown with shadows denote members of the Collin Technologies Leadership Team.

1999 Application Form

Malcolm Baldrige National Quality Award

1 Applicant

Name: Collin Technologies

Mailing Address: 624 Industrial Court

Nashville, TN 37217

2 Award Category (Check one.)

___ Manufacturing ___ Service ✓ Small Business

___ Education ___ Health Care

Criteria being used (Check one.)

✓ Business ___ Education ___ Health Care

3 Official Contact Point

Mr. Mrs. (Ms.) Dr.

Name: Michelle Blanton

Title: Director, Continuous Process Improvement

Applicant Name: Collin Technologies

Mailing Address: 624 Industrial Court

Nashville, TN 37217

Overnight Mailing Address: (same as above)

Telephone No.: (615) 555-4110

Fax No.: (615) 555-4115

4 Fee (See page 5 for instructions.)

Enclosed is $ 1,500 to cover one application report and -0- supplemental sections.

Make check or money order payable to:

The Malcolm Baldrige National Quality Award

5 Release Statement

We understand that this application will be reviewed by members of the Board of Examiners.

Should our organization be selected for a site visit, we agree to host the site visit and to facilitate an open and unbiased examination. We understand that the organization must pay reasonable costs associated with a site visit.

If our organization is selected to receive an Award, we agree to share nonproprietary information on our successful performance excellence strategies with other U.S. organizations.

6 Signature, Highest-Ranking Official

Date 5/24/99

X Candice Trobaugh

Mr. Mrs. Ms. (Dr.)

Name: Candice Trobaugh, Ph.D.

Title: Chief Executive Officer

Applicant Name: Collin Technologies

Mailing Address: 624 Industrial Court

Nashville, TN 37217

Telephone No.: (615) 555-4110

OMB Clearance #0693-0006
Expiration Date: June 30, 1999

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Business Overview

1. Basic Description of the Company

Collin Technologies (Collin) applied for the Malcolm Baldrige National Quality Award in 1992 and received a site visit. The feedback report was extremely valuable, and all high-priority improvement opportunities were addressed. In 1995, the company was restructured, and a new Chief Executive Officer (CEO), Candice Trobaugh, Ph.D., was installed.

Candice Trobaugh brought the company to a new level of performance with her dynamic leadership. Subsequently, Collin developed a new standard of cutting-edge technology performance in multilayer printed circuit boards using technology that resulted in quick reaction time to customer needs and high product quality beyond anything available in the industry.

This has been accomplished with a paperless, fully automated process providing total customer satisfaction through training of employee/owners (EOs) and with a fully interactive data system interconnected to all EOs, major customers, and preferred suppliers. This has resulted in a work force that is fully motivated and trained to accomplish what were once considered impossible goals.

Collin was formed in 1971. It was organized to focus on multilayer printed circuit boards with concentration on advanced materials for very high frequencies (gigahertz), and more demanding environments with fine lines and spacing for high densities. Attached components are high reliability parts. During recent years, the technology has moved from discrete component parts to surface mounted parts with many types of integrated circuit chips.

Collin recently initiated a proprietary process called the Chemically Bonded Deposition Process (CBDP). The process results in smaller, lighter boards with fewer layers. This process was developed primarily for the Advanced Technology segment of the business and will have applications in additional market segments.

The company has facilities in two locations. The original site is in Nashville, Tennessee, and the second location is in Koga, Japan. Both facilities have similar equipment and identical processes. The total number of EOs is now 390 — up from the total of 178, who were located at the Nashville location at the time of the prior Baldrige application.

In 1993, the company entered into a 15% Employee Stock Option Plan (ESOP) with the EOs. EOs are now personally involved and financially motivated owners of 15% of the otherwise privately owned company. The remaining 85% is retained by management, with no individual owning as much as 51%.

Collin's purpose for existence is simple: **Collin exists to understand complex systems and to manufacture them for the benefit of a global society**. To support this purpose, Collin has firmly established an overall mission with five straightforward Core Values called "Baugh's 5." They are:

"To become better at improving our:

- Products/Processes;
- Employee/Owners' Careers;
- Use and Reinvestment of Profits;
- Communities; and
- Customer and Supplier Relationships."

The purpose and Core Values are continually reinforced in many ways for all EOs to understand.

The company has evolved from a quality assurance orientation to a continuous quality improvement, prevention-based environment with emphasis on knowledge-based EOs, working in an integrated, highly automated, paperless system. Market penetration has increased by accomplishing complete customer satisfaction.

The company has embarked on a technical initiative that includes full automation of the design-through-production facility utilizing EOs in "thinking" rather than "doing" positions. Collin continues to utilize these concepts as it moves into more complex products and welcomes more demanding customers. Leadership is the key in driving this process.

The company concentrates on having a customer focus that maximizes profit over revenue by providing high technology products in very short periods of time at superior quality levels. This provides higher returns for the large investments required by this capital-intensive business.

Although customer needs have increased revenues six-fold, the size of the work force has only doubled since 1991. EO output in sales dollars has increased three times as the result of completely automating processes. New EOs are trained in the basic concepts and the culture of the company in the United States as well as in Japan. This includes ongoing retraining of experienced members of the work force. EO retention has been significantly better than the norm for the industry at both Collin facilities. The key is the integration of the EOs with technology.

Both facilities are recognized to be ISO 9001 compliant. Due to the fact that Collin's facilities were so advanced in internal assessment and process documentation and control, the ISO registrar declared the facilities to be

in compliance with ISO requirements without the normal pre-audit and final compliance review. The registrar accompanied the company auditors as they made their regular facility reviews. His observations were sound enough to convince his company to make the declaration of compliance. Thus, Collin has been recognized as fully compliant to ISO 9001 requirements since 1997. For the regular periodic reviews, the registrar brings in prospective clients to show them how a facility should demonstrate compliance. During these reviews, the registrar representatives observe and approve Collin's ongoing compliance to the ISO 9001 requirements without the normal surveillance audits.

North America and the Far East make up the majority of Collin's overall market share. Collin expects Europe to be a key contributor to future market share growth.

Because some of its end customers are domestic or foreign governments who use Collin products to meet the demanding requirements of aerospace, the quality and reliability of Collin products are directed to the cutting-edge performance of printed circuit board capabilities.

The company has a technical base of 95 people (over 24%) who collectively hold 15 Ph.D's, 35 Master's degrees, and 45 Bachelor's degrees in such disciplines as Mechanical, Chemical, Electrical, Materials, Industrial and Manufacturing Engineering, and Information Systems. The executives, managers, and supervisors are included in these numbers. Currently, all EOs have at least a high school diploma.

There are 195 factory EOs and an additional 100 in support areas. The company does not have, nor has it ever had, a union. Collin has a functional organizational structure, but relies heavily on teams to accomplish its work. Directors, managers, and supervisors are assigned to a specific function and have managerial responsibilities, including managing and developing the EOs within the function. Team leaders are responsible for managing the activities of the standing and ad hoc teams, including cross-functional Integrated Product Development Teams (IPDTs) and Process Support Teams (PSTs) that have primary responsibility for product development and performance improvement. Team leaders are selected based on their qualifications to lead a specific team; they may also have responsibilities as a director, manager, or supervisor in a functional organization, but functional management is not a requirement to be a team leader. Most EOs (including directors, managers, and supervisors) participate on one or more teams, but some are in "individual contributor" roles, supporting teams as subject matter experts.

The technical requirements of Collin's products mean significant capital investments, including facilities such as computer-controlled plating lines that require continual updating. The updating requirements for facilities effectively mandate total replacement in about five-year cycles. Software modifications and changes are also continual.

The facilities operate 24 hours a day, seven days a week, to meet customer needs and optimize capital investments. The facilities are fully automated from design inputs through production. Prototype boards are usually made in the same automated facility to maintain total process control. A process laboratory with automated equipment and associated processes is available to process engineers and product design engineers for the development of prototype boards, environmental sample testing, and, if necessary, verification of modified processes.

The automatic inspection equipment involves a demanding process. All boards produced are electrically tested and automatically inspected to ensure design compliance with guidelines to meet complete customer satisfaction. The automated inspection of lines and spaces includes the inner layers as well as the completed board assemblies.

Collin has installed a comprehensive data system, the Collin Advanced Integrated Network (CAIN), which is beyond anything found in benchmarking evaluations. By utilizing this system, EOs are able to understand customer needs and make fully empowered market decisions on a real-time basis.

The CAIN system provides electronic access to Collin's customers and suppliers through "Collin Link" (an Intranet-based electronic data interchange, wide area network). If desired, all customers can place orders, check order status, and/or make inquiries and complaints, as well as receive shipping notices, invoices, surveys, reports, and other stakeholder information electronically. Additional access is provided to major customers, including direct input to their product design parameters in the CAIN design database. With this capability, major customers are able to change their product specifications quickly. If the customer's updated specifications do not pass the edit checks built into CAIN or if the customer does not have access to the CAIN design database, a Collin engineer works with the customer to update the product design parameters. Like customers, all suppliers can send and receive information related to specific orders, but preferred suppliers' access is much broader. For example, supplier requirements are transmitted to a not-yet-preferred supplier when the supplier is selected as a source for a specific product or service. Preferred suppliers have access to supplier requirements on an ongoing basis and can access technical specifications and

required quantities for future as well as current needs. Collin's remaining stakeholders, the community and shareholders, are linked to the company via free Internet-based web e-mail.

Cleanliness and control of the work environment in the production facilities are important. By maintaining low humidity, bake times have been reduced to aid in customer response times. The inner layers of the multilayer board assemblies are "stacked" in a low-humidity, clean room environment that keeps out any foreign materials, including moisture, that might be sealed into the boards during the bonding process.

Because some chemicals used in the production of printed circuit boards are toxic, safety is a prime issue. The company is proud of the fact that its safety results are truly world class. Collin is a leader in safety achievements and is not merely compliant to existing regulations.

The company has a process that proactively examines new processes and materials to determine any possible hazards to the EOs, as well as the environment. Collin recognizes its responsibilities to the communities of Nashville, Tennessee, and Koga, Japan, and to EOs at both sites.

In the United States, the chemicals and chemical processes utilized require compliance with regulatory requirements enforced by the Environmental Protection Agency, the Air Quality Management District, the HazMat Affairs Office, the State of Tennessee, OSHA, and others.

In Japan, the National Department of Environmental Affairs, the City of Koga Environmental Council, and the National Safety Agency have jurisdiction over Collin's activities.

Wastewater treatment is extremely important due to the presence of copper in the wastewater as a result of the copper etching process. Wastewater content is constantly monitored and periodically observed by various governmental agencies. Protection of EOs has always been a priority issue at Collin. Elimination of this copper waste is a primary goal of the CBDP.

Collin's environmental compliance system has been recognized as a "model system" by Tennessee and Japan. It has received multiple awards from *Industry Magazine* and *Printed Circuits Today*.

Over the last ten years, neither Collin location has received any sanctions or notices of noncompliance with governmental or local requirements concerning air, water, or solid waste discharge. Collin is very active in recycling activities. No manufacturing materials are shipped to landfills.

2. Customer and Market Requirements

The business is organized to satisfy the needs of four market segments: Government, Commercial, Advanced Technology, and Industrial Products. Each business segment has a manager who is responsible for customers in that segment, coordinating the market information and ensuring that reliable data flow into the Perennial Planning Process (PPP). Sales coordinators are responsible for day-to-day interaction with their assigned customers.

Government - This segment consists of U.S., Chinese, and Japanese customers including the Defense Agency, the Department for National Security Matters, and the Federal Space Council, as well as other foreign governments. This segment requires small quantities of highly reliable products designed primarily to customer specifications.

The Federal Space Council has an innovative procurement program which focuses on technology, and Collin has taken a partnership role in promoting and facilitating this program, using its advanced techniques, processes, and materials.

Commercial - These customers use printed circuit boards in products they manufacture to be resold to other businesses. Examples include automotive, electronic consumer products, telecommunications, computers, and many more. This segment requires the use of new technologies that will give these customers a competitive advantage and ways to differentiate their products.

Advanced Technology - This segment consists of customers around the world who often develop products that are on the leading edge of technology. Such products solve problems that have not been solved before. These customers demand advanced materials for use with very high frequencies, often under extreme environmental conditions such as deep space where reliability is essential.

Industrial Products - This segment consists of industrial companies around the world that use printed circuit boards in their own processes for process control. These customers are most concerned with product quality and reliability. Rapid reaction to design changes is important as these customers deliver their products with very short lead times and rapidly changing technical requirements.

Although customers sometimes have technical suggestions, they often rely on Collin to provide solutions. All customers require short lead times with rapid response to engineering design changes.

The company has established partnerships with key customers who rely on the high value of products delivered on-time to stringent quality and just-in-time (JIT) requirements.

Collin utilizes sales coordinators to develop customer relationships. As part of Collin's Customer Support Department, they serve as contacts for customer information and feedback, provide sales and service assistance, and conduct some marketing functions. To support its expansion into Asia and Europe, Collin created international sales coordinator positions. These EOs perform the same function as sales coordinators, but are also responsible for addressing the unique needs of their customers (e.g., language and cultural differences, time differences). There are three international sales coordinators each for Europe and Asia, and they are based in Nashville and Koga, respectively. However, to ensure that they understand their customers' needs, they are recruited from the geographic regions they serve and usually speak at least three languages. In addition, their work schedules are established to ensure that they are available during their customers' business day, and (like all sales coordinators) they carry beepers to ensure ready access during other hours.

Major customers incorporate design changes directly into the CAIN design database. Changes for other customers are input by Collin engineers. In either case, prototypes are generated the same day and shipped to customers by overnight carrier. Production quantities are available within five calendar days of the design change.

Key customer and market requirements are:

1. High quality;
2. High reliability;
3. Competitive prices;
4. On-time delivery;
5. Short delivery cycles;
6. Rapid response to customers;
7. Cutting-edge technology; and
8. Stable precision dimensions.

To ensure customer satisfaction and to accomplish all the objectives of the company, results data are extensively utilized. Customer satisfaction is continuously measured with surveys performed by Collin and independent third parties. Comparisons with competitors and applicable benchmarks throughout the world are collected in keeping with the size of Collin's operations and available assets.

Circuit boards produced by Collin, although complex in themselves, have component parts installed that are much more costly. This requires a significantly high level of quality and reliability. Collin has maintained a quality level in parts-per-billion defects for the last four years.

No products have failed production tests in the last three years. This quality level has been maintained through the use of process control, with process capabilities that are better than a Cpk of 2.0 maintained throughout the production process.

Collin maintains a written lifetime product warranty on all circuit boards. This includes a full warranty to repair or replace any defective product that the customer believes is Collin's responsibility.

Although quality and reliability are essential to customers, cost of the products is also very important. With continual pressure to reduce prices of electronic products, the costs of Collin's delivered products to its customers must also be reduced. To retain its valuable customers, Collin has granted annual price reductions that range from 1% to as much as 10% for volume purchases and for special situations where customer links have resulted in lower costs for Collin.

3. Supplier and Partnering Relationships

Suppliers are segregated into two categories: manufacturing suppliers (product-oriented) and service providers. Service providers support the CAIN information system, computer software and hardware, education and training, and back-up systems.

Collin works closely with manufacturing suppliers to produce boards that perform in extreme environments, and it is continually developing requirements for new and extended performance. As a result of technical breakthroughs, Collin often delivers new technical accomplishments. Also, a customer may change contractual requirements within an order. It is essential that suppliers deliver materials of the highest quality to Collin. With tight lead and reaction times, there is no time for product failures within the production process or at the customer's facility.

Suppliers have learned that Collin is leading the technology base, and special requirements today are likely to be common requirements of users in the future. Thus, suppliers can lead their competitors in required technology by working with Collin. Suppliers also are a key source for comparative competitor data, benchmark processes, and metrics. They also have input to the PPP — the Collin strategic planning process.

Collin maintains a list of 96 suppliers, 50% of which are preferred suppliers. To achieve preferred supplier status, a supplier must rate 95% overall and above 90% on each of five performance dimensions:

1. Quality;
2. Cost;
3. Availability and delivery;
4. Technology; and
5. Continuous improvement.

Preferred suppliers are those that share 100% Electronic Data Interchange (EDI) connectivity and are full participants in the Integrated Product Development Teams.

For preferred suppliers, Collin performs no incoming inspections. It continues to reduce production lead times and production costs.

4. Competitive Situation

Collin maintains about a 10% share of the multilayer printed circuit board market — as large a share as any producer among those in the business. The sales growth of six-fold since 1991 is the largest growth rate in the industry.

Collin's major competitors, which are all international companies, are KTFL, Ace Circuits, Ridgeford Technology, and Worldwide Corporation. International competition continues to be a major business factor.

Collin maintains competitive leadership by using preferred supplier partnerships and maintaining a cutting-edge profile for changes in circuit board technology (CBT).

5. Business Directions

The company has maintained its Total Quality Management (TQM) philosophy, adding the Trobaugh leadership system in 1995, and has continued to adhere to the Baldrige principles. Although the prevention-oriented process remains strong, Collin's focus is also on continuous improvement. As the Baldrige *Criteria for Performance Excellence* are published each year, formal self-assessments are continually performed to ensure complete conformance to the Criteria.

Collin is actively pursuing ISO 14000 certification and the anticipated Year 2000 revision of ISO 9001. The company expects to receive compliance approval in the same manner as the original ISO 9001 certification was received.

Due to the type of customers Collin has, it receives many visits and surveys by individual customers. Collin has experienced great success in these surveys, and none have resulted in corrective action requests.

Collin plans to establish a European facility in Belbonne, France, to provide future expansion capabilities as market share grows in Europe.

Collin introduces new technology on a continuing basis. New materials are used and new processes are initiated as soon as they are discovered from a wide range of inputs from customers, suppliers, EOs, industrial sources, and academic institutions around the world.

Collin receives strategic direction from all EOs rather than via the conventional top-down approach. In particular, international sales coordinators provide insights regarding customers based outside the United States. Customers and preferred suppliers also provide valuable input of a strategic nature.

Collin has faced the year 2000 (Y2K) problem, and all issues will be resolved by the second quarter of 1999.

Collin's Quality Policy promises that: "The company will meet or exceed the customers' expectations in every product or service we provide, without exception."

Glossary of Terms and Abbreviations

ACE	Association of Collin Employee/Owners
AEA	American Electronics Association
AT	Advanced Technology Customer Segment
Baldrige	Baldrige National Quality Program
BAT	Best Available Technology
BC	Collin's Best Competitor Performance
BSC	Balanced Scorecard
C	Commercial Customer Segment
CAIN	Collin Advanced Integrated Network
CBDP	Chemically Bonded Deposition Process
CBT	Circuit Board Technology
CCE	Customer Contact Employee
C/E	Cause and Effect
Cpk	A Process Capability Index
CT	Collin Technology
DT	Design Teams
EDI	Electronic Data Interchange
EEOC	Equal Employment Opportunity Commission
EHS&S	Environmental Health, Safety, and Security
EO	Employee/Owner
EPA	Environmental Protection Agency
ERT	Emergency Response Team
ESOP	Employee Stock Option Plan
G	Government Customer Segment
HR	Human Resources
HRC	Human Resource Council
I	Industrial Products Customer Segment
IIE	Institute of Industrial Engineers
IPDT	Integrated Product Development Team
IS	Information Systems
ISO	International Organization for Standardization
JIT	Just-In-Time
LAN	Local Area Network
MRD	Marketing Requirements Document
OPR	Output Results measures (lagging)
OSHA	Occupational Safety and Health Administration
OTJ	On The Job Experience
PDP	Product Development Process
PDR	Performance Results measures (leading)
PMC	Performance Management Cycle
POR	Plan of Record
PPM	Parts Per Million
PPP	Perennial Planning Process
PRD	Product Requirements Document
PST	Process Support Team
R&D	Research and Development
ROI	Return on Investment
RONA	Return on Net Assets
ROR	Return on Revenues
SBP	Strategic Business Plan
SPC	Statistical Process Control
TQM	Total Quality Management
TVG-BJV	Tennessee Valley Government and Business Joint Venture
VOC	Volatile Organic Compound
WAN	Wide Area Network

1 Leadership

1.1 Organizational Leadership

Collin Technologies (Collin) has both accelerated and revitalized its leadership system since the last formal Baldrige application process. Many changes have been made, including the retirement of Roger Brown, the past Chief Executive Officer (CEO). The most significant changes have occurred under the current President/CEO, Candice Trobaugh, Ph.D. She was hired by Roger Brown in 1995 prior to his retirement to lead Collin to the forefront of technology and quality excellence. Prior to Candice Trobaugh's arrival, the senior executives were actively involved in the creation and implementation of the existing prevention-based TQM system and were committed to improving the business through personal leadership practices. However, the changes led by Candice Trobaugh focused the company's direction and established a common set of Core Values that stressed blending technology with prevention-based quality practices. Over the past five years, Collin has integrated technology into the Collin TQM System. This has led to double-digit growth while improving Collin's overall position in the eyes of all stakeholders.

1.1a Shortly after her arrival, Candice Trobaugh and the Leadership Team spent one week together in Memphis analyzing existing strengths, weaknesses, and overall success inhibitors. The team was the first to use the now institutionalized "5-Step" analysis process (Figure 4.2-1) to help define a set of core values, overall company mission, and strategic direction. This "5-Step" process is now used to analyze all key information and identify improvements. From this meeting, the following mission was created:

Through the use and integration of technology with proactive quality practices, Collin Technologies will not only provide the best circuit board products to its customers, but will also provide to all stakeholders partnership performance solutions that will allow each stakeholder to excel and achieve continued leadership positions of excellence.

At this meeting, the Leadership Team also defined the Core Values of the company. These values (Figure 1.1-1), called "Baugh's 5," are simple and straightforward. The five stakeholders are noted in italics in Figure 1.1-2. The Leadership Team itself is made up of seven members and the CEO. As shown in Figure 1.1-2, specific members of the team are held accountable for advancing Collin's position and relationship with each of its five stakeholders. Candice Trobaugh oversees the team activities and is an active participant. The two remaining members act as chair and peer reviewer for the team. The entire team is responsible for balancing and prioritizing the needs of all stakeholders.

Become Better at Improving

Our:

1 – ***Products/Processes***
2 – ***EO's Careers***
3 – ***Use and Reinvestment of Profits***
4 – ***Communities***

Business and Relationships with:

5 – ***Customers and Suppliers***

Figure 1.1-1 Collin Technologies' Core Values – "Baugh's 5"

There are seven-person Stakeholder Teams with representation from all levels and areas of the company (direct and indirect). These teams meet every two weeks to work on yearly improvement objectives related to their assigned stakeholder. Members serve for one year and work with their replacements for three months to educate and bring new members up to speed. Throughout the company, employee/owners (EOs) know what the overall mission and Core Values are as these are presented at the beginning of every quarterly all-hands meeting. In addition, every computer displays the "Baugh's 5" as a screen saver. Every conference room proudly displays the Core Values and associated team member names. The status of Stakeholder Team performance is presented over the company Intranet system one week after the bimonthly reviews are conducted (Area 1.1b and Figure 1.1-3).

Leadership Team Member	Stakeholder Responsibility
Candice Trobaugh, Ph.D.	Overseer for Team
Michelle Blanton	Team Chair
Robert Vallone	Team Peer Reviewer
Bob Yacobi, Ph.D.	*Customers*
Vincent Daubert, Ph.D.	*EOs*
Georgio Michelli	*Suppliers*
Paul McNulty	*Shareholders*
Larry Johanson, Ph.D.	*Community*

Figure 1.1-2 Leadership Team Responsibilities

Candice Trobaugh came to Collin with the concept that the best way to move a company forward in today's society is to make improvements by systematically integrating the use of technology with prevention-based practices. She stated, "Technology should not be used to measure defects, but to prevent them." Labor intense processes have been replaced with technology intense processes presenting dramatic changes in the approach Collin took to making products available to customers

and working with suppliers. It also presented many learning opportunities for EOs and forced everyone to transition from a skill-oriented work force to a knowledge-oriented work force.

Based on this direction to integrate technology, the company's TQM system has evolved from a paper-oriented, measurement-driven quality assurance system to a continuous quality improvement environment that utilizes available technology and emphasizes proactive, forward-thinking, paper-free practices to virtually eliminate schedule delays and process errors. In accomplishing this, all EOs have had to evolve from a skilled labor work force to a knowledge-based work force capable of using fully automated manufacturing equipment and a paperless interactive data system known as the Collin Advanced Integrated Network (CAIN), which is interconnected to all EOs, customers, and preferred suppliers. This transition has offered a wealth of learning opportunities for all EOs and has resulted in a work force of fully motivated and trained individuals, working together to accomplish what were once considered impossible goals (including the "lifetime" circuit board warranty).

In addition to driving the Stakeholder Team meetings, Candice Trobaugh and each of her direct staff are required to devote at least one hour each day talking to and getting to know EOs in an operation different than their own. Formal meetings, roundtable discussions, and conference room time is not counted as part of this hour. At the weekly one-on-one sessions with Candice Trobaugh, each of her direct staff is required to report on how they spent this time and with whom they talked. Any significant input is electronically recorded into the appropriate Stakeholder Team diary log. Candice Trobaugh feels this time is extremely valuable in order to communicate the leadership direction, reinforce values, assess personal performance, understand what goes on in other operations, instill trust within the work force, and get to know and become known by all EOs. This time is an excellent way to capture inputs from all EOs. This model is also being used in the Koga, Japan, facility.

Twice a year, the Leadership Team has a two-day off-site meeting to reflect on leadership practices that worked and those that did not work. The first day of this off-site meeting is devoted to understanding information from EOs, suppliers, customers, shareholders, and community leaders to identify future opportunities. The second day is divided into two sessions. The first session is used to analyze why successful practices work and how these can be improved. The second session is used to identify why unsuccessful practices failed and if these need to be eliminated or how they can be modified to become more successful. No leadership practice or technique is eliminated without first going through this off-site review process.

Two examples of mediocre performance practices being successfully modified pertain to the Customer Stakeholder Team and the Employee/Owner Stakeholder Team. The Customer Stakeholder Team was struggling to meet the goal of "*meeting or exceeding the customers' expectations in every product or service we provide, without exception*" (Collin's Quality Policy). The primary focus of EOs was on producing products, and they were not aware of the real customer issues and/or needs. To make EOs more aware of customer issues and to better identify customer needs, it was decided that each key customer be assigned a senior manager as the primary listener/liaison contact. These managers are required to either visit or contact by telephone their assigned customers at least once each quarter. Managers also are required to include other EOs in these conversations or visits to hear firsthand the customer's feedback relative to performance and delivery. Based on these meetings between the EOs, managers, and customers, much of the focus now is on what can be done to meet customer needs, not just get the product out.

In 1996, the Employee/Owner Stakeholder Team identified a unique process based on a suggestion from one of the line team members. Based upon inputs from peers, EOs stated that the only real way senior executives could understand the pressures associated with manufacturing products was to actually put themselves in that position. The team took this suggestion and created the "Executive Replacement Program." Every quarter at the all-hands meeting, Vincent Daubert identifies by random selection two members of the Leadership Team (including Candice Trobaugh) to become replacement associates for a period of two weeks. Two manufacturing EOs (also randomly selected) are given the two weeks as additional vacation time. At the end of the two weeks, a team of peers evaluates the performance of the replacement executives and reports back to Vincent Daubert. This information is then used as inputs for training new personnel in the respective areas.

1.1b Many reviews are conducted over the year to assess company capabilities, measure the overall health of the company, check status, and track performance to short- and long-term goals. Figure 1.1-3 identifies some key reviews conducted by senior leaders and managers to assess organizational performance. Figure 1.1-4 shows the current set of key performance measures called the Balanced Scorecard (BSC) measures.

The Stakeholder Team review — a key review that ties directly to the Core Values — is conducted every two months. Candice Trobaugh is personally involved and oversees this performance review meeting. The sixth member (currently, Michelle Blanton) chairs this meeting and assists Candice Trobaugh. Robert Vallone (the seventh member) acts as a peer reviewer. At these meetings, the following standard agenda is followed:

1. Past Progress: Review accomplishments over the last two months.
2. Current Status: What actions are being taken to meet the yearly objective? What are the "Red/Green" Issues and their status (Area 4.2a, Figure 4.2-1)? Are additional resources needed?
3. Plans and Targets: What plans will be accomplished in the next two months? What resources are needed? How will the accomplishment improve the stakeholder relationship?
4. Technology: What technology can be applied to help meet the stated goals?

If progress has stalled or overall performance shows signs of missing the target objective, Candice Trobaugh becomes even more actively involved. She will participate as a member in the biweekly Stakeholder Team meetings, identifying necessary additional resources to bring the team back on track. Yearly stakeholder objectives are identified as part of the Perennial Planning Process [Figure 2.1-1, Action (Output) Stage].

From the many review processes, Collin identifies both strengths and opportunities for improvement. In order to prioritize and select items that have the greatest impact for the stakeholders, provide a good return to the company, and further integrate technology, Collin has developed a prioritization/decision matrix to identify key opportunities. This prioritization cube (Figure 1.1-5) is a set of three 2x2 matrices that address implementation, cost, and technology. This matrix was derived from an original 2x2 matrix that looked only at technology. By integrating inputs from both finance and human resources, the current 3x2x2 matrix cube was created. From the use of this model, priorities are assigned based on tradeoffs between: (1) cost to complete and anticipated return (higher return/higher priority); (2) technology solutions and labor intensity (low labor intensity/high priority); and (3) ease of implementation and stakeholder impact (high impact/high priority).

As part of the analysis process used by the Leadership Team prior to the semiannual off-site meetings, each opportunity is weighed against each sub-matrix, and a composite score is determined between 3 and 12 points. A total score of 8 is required before issues are brought to the off-site review meeting. At the off-site meeting, there is further discussion, and priorities are finalized. Following this, decisions to move forward on an opportunity are made, budgets are set, and resources are committed. The opportunity is then assigned to a Stakeholder Team and becomes part of the team objectives.

Team Review	Chair	Reviewing Participants	Freq.	Purpose	Measure
Stakeholder Teams	CEO	Leadership Team and members	Every 2 months	Check status, determine support	BSCs
1-on-1 Meetings	CEO	Direct staff	Weekly	Daily activities, floor inputs	Teamwork
Roundtables	Dept. Mgrs.	EOs	Quarterly	Communication, inputs from EOs	Morale
Staff Meetings	Dept. Mgrs.	Direct staff	Weekly	Communication, pass down, progress to goals	Goals
Off-Site Meeting	CEO	Leadership Team	Twice/ yearly	Progress to goals, goal setting, direction changes, improvements	Performance
BSC Review	CEO	Leadership Team and operational depts.	Monthly	Organizational performance, internal operations	Performance
All Hands	CEO	EOs	Quarterly	Internal performance, goals, and plans	Performance

Figure 1.1-3 Key Reviews to Assess Organizational Performance

BSC #	Measures	Type	Linked to This OPR
7.1-1	Customer Satisfaction	Leading	7.1-3 Customer Complaints
7.1-3	Customer Complaints	Leading	7.1-4 Win Ratio, Referrals, etc.
7.2-7	Net Asset Turnover	Leading	7.2-5 Return on Net Assets
7.2-8	Asset Reinvestment Rate	Leading	7.2-4 Profit Growth
7.2-9	Inventory Turns	Leading	7.1-7 On Time-Delivery
7.2-11	Warranty Activity	Lagging	7.2-1 Revenue Growth
7.2-12	Times Interest Earned	Lagging	7.2-6 Return on Revenues
7.2-14	Market Share	Leading	7.2-1 Revenue Growth
7.2-13	Sales from New Products	Leading	7.2-1 Revenue Growth
7.2-16	Customer Growth Rates	Leading	7.2-1 Revenue Growth
7.2-17	Expansion of International Sales Coordinators	Leading	7.2-3 Revenue by Global Market
7.3-3	Satisfaction with Development Opportunities	Leading	7.3-4 Satisfaction With Training
7.3-5	Satisfaction with Support Climate	Leading	7.3-1,2 EO Satisfaction
7.3-9	Suggestion Program	Leading	7.3-8 Turnover
7.4-7	Preferred Suppliers (Growth)	Lagging	7.4-6 Material Cost
7.4-8	Supplier Ratings for Preferred Suppliers	Lagging	7.2-4 Profit Growth
7.4-9	Not Yet Preferred Supplier Ratings	Leading	7.2-4 Profit Growth
7.5-1	Cycle Time Improvement	Leading	7.2-4 Profit Growth
7.5-2	Improvement in Production Cost	Leading	7.2-1 Revenue Growth
7.5-3	CAIN Operational Effectiveness	Leading	7.2-4 Profit Growth
7.5-7	Planned Schedule Execution	Leading	7.1-7 On-Time Delivery
7.5-8	EHS&S Audit	Leading	7.5-14,15,16 Environmental Results
7.5-10	Unit Price Improvement	Leading	7.2-4 Profit Growth
7.2-10	Value Adds	Leading	7.2-4 Profit Growth
7.1-9	Field Quality Index	Lagging	N/A
7.3-8	Turnover	Lagging	N/A
7.5-6	Energy Dead Time	Lagging	N/A
7.5-12	% Processes with Cpk > 2.0	Lagging	N/A

Figure 1.1-4 Balanced Scorecard (BSC) Measures

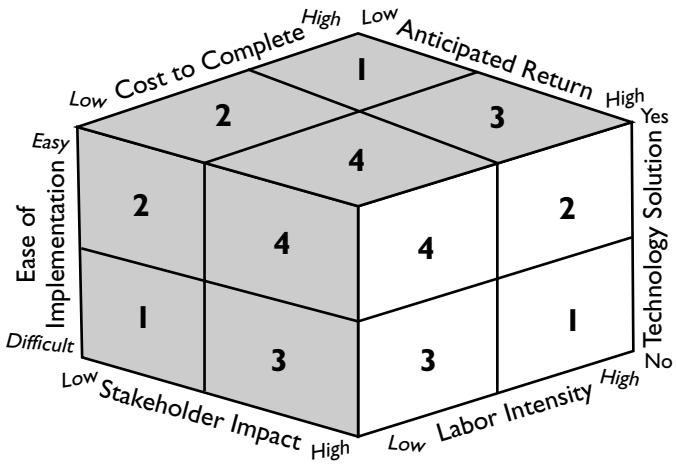

Figure 1.1-5 Prioritization Matrix to Identify Key Opportunities

Two recent findings, their matrix scores, and methods of implementation are shown in Figure 1.1-6. The primary method of deploying the findings is through the Stakeholder Teams and the use of CAIN (Area 4.2a).

Part of each team member's responsibility is to solicit inputs on a quarterly basis from their stakeholders for use in the team meeting. One meeting each quarter is focused completely on inputs from stakeholders, and another is focused on responses back to the stakeholders. This ensures that every stakeholder has a means to voice an opinion, suggest a change, present a challenge, offer a solution, or just provide input. All inputs are addressed and answered through CAIN within the quarter. Collin EOs can also voice their inputs directly through their personal computers or any of the public computers throughout the company. As part of the screen saver program, CAIN provides a link to the Stakeholder Team suggestion system. Collin's corporate website also

Opportunity From	Matrix Score	Priority	Opportunity Description	Stakeholder Team Assigned	Results
Customer	11	Medium (High return)	Customer wanted direct access to contact points via single number for voice-mail, cell phone, pager	Customer	Changed service provider to allow auto forwarding of work phone to voicemail, cell phone, pager
Staff Meeting Review	10	Medium	EOs could not access financial stability or position	EO	Confidential link provided in CAIN to internal EOs

Figure 1.1-6 Examples of Prioritization Matrix Scores and Implementation

provides this link to customers, suppliers, and shareholders. Comments, suggestions, or questions go directly to the team leader via e-mail and to the team diary log. These inputs are also responded to on a quarterly basis.

1.2 Public Responsibility and Citizenship

At Collin, one of the Core Values is to become better at improving the community. To do this, the company does more than just comply with regulatory and legal requirements associated with the manufacturing of products. It strives to set the precedent for excellence. Collin advances its business and relationships with regulatory agencies so that the goals of both are met to serve the community.

1.2a Collin's processes and products, if not properly controlled, could have a major impact on the current and future state of the community. These impacts relate to:

1. Public Health (workplace and community risks);
2. The Environment (air and water pollution);
3. Waste Management (landfill, control of solid waste, and recycling); and
4. Energy Management.

Because of these potential impacts, the circuit board manufacturing business is highly regulated and subject to frequent audits by the EPA, OSHA, Air Quality Management District, and HazMat Affairs Office, as well as many other city, county, and state agencies and their equivalents in Japan. Over the last ten years, no violations, fines, or sanctions have been imposed on the company. To maintain this perfect record and address future societal impacts, Collin has set up specific Public Health, Environmental Improvement, Waste Management, and Energy Conservation Risk Management Teams. It is the responsibility of these teams to identify potential exposures, define control practices, establish measures, and set stretch targets to drive proactive improvement, not only within the company, but also with the regulatory agencies. Figure 1.2-1 identifies some of the risks, practices, measures, and targets associated with these areas.

The Public Health Team (led by Shirley Ogrysko, Director, Health, Safety, and Security Services) is chartered to work with OSHA and all public health organizations in the community. Her team personally audits all facilities for maintenance of "Material Safety Data Sheets," hazardous material exposures, and potential safety or health violations. The team also works closely with the Tennessee regulatory board and many insurance carriers, often accompanying them on routine audits. Improvement goals are set in conjunction with the local fire department and emergency planning committee. Shirley is an active member of the local emergency planning committee and serves as a consulting member to the state Department of Emergency Planning. In this role, she not only becomes aware of future criteria, but also has a major part in setting the future direction of public health and workplace safety requirements. Within Collin, Shirley oversees the activities of the Safety Committee, HazMat Team, and Emergency Response Team (ERT). The Red Cross certifies every ERT member to administer first aid and handle workplace trauma incidents.

Fred Fischer, Ph.D. (Director, Production Engineering, and Chief Environmental Officer), leads the Environmental Control Team. He and his team have set the standard for excellence in the area of workplace environmental controls. Fred Fischer is no stranger to environmental programs. He has been an active member of "A Green Society" for the last three years and currently chairs the regional "Better Air for Factories" Subcommittee for the state Air Quality Management District. The team's approach used technology to advance Collin's position in the area of environmental compliance. Its first objective was to make all Collin operations free of Volatile Organic Compounds (VOCs).

Area	Risk	Practice	Measures	Targets/Goals
Public Health	Lead exposure	Quarterly EO blood testing	% lead in blood	<0.2% of legal limit
	Chemicals in air	Monthly monitoring	% hazardous chemicals in air	0.00% induced chemicals
	Chemical handling	Daily audits	No. of violations	0.00% handling violations
Environmental	VOCs	VOC filtering	% VOCs in air	0.00%
	Water contamination	Reclamation process	Purity of water	99.9%
Waste Mgmt.	Landfill	Recycle process	Tons of recycled material	95% of all waste material
Energy Conservation	Global warming	Minimize usage	Equipment use efficiency	90% used when on

Figure 1.2-1 Risk Management Practices, Measures, and Targets

This was accomplished through the development of a Class 1 Microfilter that, when attached to emission-producing equipment, captured and eliminated all VOCs being released into the air. The filter also automatically creates, separates, and catalogues emission reports daily. In 1997, Collin received a patent on this technology and is currently offering the Microfilter process to its customer and supplier base. The team is also working with the EPA to set up licensing agreements to offer the technology as a "Best Available Technology" (BAT) to the general business public. To anticipate future requirements, Fred Fischer has assigned members of his team to sit as active members on environmental boards, both at the state and national level.

Andy Waterman (Director, Support Contracts) leads both the Waste Management Team and the Energy Conservation Team. In 1987, Collin set a goal to eliminate solid waste from its manufacturing operations. This was accomplished by changing the handling and de-trash processes and in-plant reclamation and recycling programs. Suppliers who have reached Step 3 (Figure 6.1-2) are now required to supply material only in recyclable or reusable containers. In-house, solid waste recycle bins have been strategically placed throughout all buildings, and the Waste Management Team monitors the tonnage reports monthly to ensure no drop-off occurs in the material being recycled. Because the business requires a tremendous amount of water usage, Collin has installed a building-wide reverse osmosis system and reclaims over 90% of all process water. This water reclamation process has been certified by the Tennessee Water Utilities Board and is tested by the board on a quarterly basis. Water quality measurements are taken, and reports are submitted to the board each month. Collin has been recognized by the state as a "Model System," and the state encourages other companies to visit one of Collin's facilities.

Energy conservation is also key to Collin's success. To this end, all heavy energy use equipment is monitored for non-use time. (This is called the Energy Dead Time Indicator.) Through monthly reviews, the Energy Conservation Team identifies equipment displaying a high energy dead time. It works with Operations to automatically shut down or suspend this equipment, thus reducing the dead time. Building lights are on timers and motion sensors. Since 1995, Collin has been able to reduce wasted energy by over 75%. A software program is currently being evaluated that would automatically sample the activity of all PCs in the company and selectively suspend their power based on non-activity, much like a screen saver program for monitors. The program can be installed on the LAN and administered by CAIN. When implemented, it is estimated that this program will reduce power consumption of personal computers by over 60%.

Business ethics is another area in which Collin does not compromise. All EOs are trained for four hours on this subject. Also included in this training is a review of the Collin Business Conduct Procedure. At the end of the session, each EO takes a test and signs a condition of understanding and practice statement regarding company ethics. The Business Conduct Procedure covers customer interactions, gifts, outside work, competitors, harassment, supplier relations, and software use. In addition, CAIN software has built-in polling and licensing checks. Daily, it scans all computers for unlicensed software and flags the Information Systems (IS) group when strange or unlicensed software is found.

1.2b Collin provides support and works to strengthen the community in four specific areas: education, government, health, and general community activities. It allows each EO up to one paid day per month to participate in related community activities.

In the area of education, EOs work with the local community and state colleges to bring business and learning closer. Many senior executives conduct presentations on circuit board technology (CBT) at Peak State University, University of Koga, and community colleges. In the Engineering Department of Peak State, Collin set up a working lab for students to design and fabricate circuit boards. A similar lab is being constructed in the University of Koga in Japan. Collin has donated valuable equipment to the universities. Fred Fischer teaches evening classes on environmental controls in a business operation as part of the Peak State University MBA curriculum. Every summer, Collin supports both the community and state colleges by hiring co-op students. These students are asked to return each summer until they graduate. Students who remain in the program are immediately eligible for hire upon graduation. The Collin computer training center is open and staffed for use by the local K-12 schools. Classes are conducted in basic computer training for K-12 students who desire to learn or further their skills. Instruction is given on word processing, spreadsheets, graphics, and the Internet. These classes, which run from 9:00 a.m. to 1:00 p.m. on Saturdays, include lunch for the students. Between 1:00 p.m. and 6:00 p.m., the computer center is open for students to complete assignments or conduct research on the Internet.

In the area of government support, as mentioned previously, Collin works with regulatory agencies to better align the needs of the agencies to the business processes. In addition, Collin works with permit agencies to streamline processes that will facilitate the construction of new plants.

Collin also is active in the Tennessee Valley Government and Business Joint Venture (TVG-BJV) program, chaired by the Mayor of Nashville, and whose initiatives are designed to make the Tennessee Valley a model for integration of business and government.

The Public Health Team has identified a number of programs to train and enhance the community. In addition, the ERT offers Tornado Survival Classes each month, and the ERT in Koga conducts similar classes for Earthquake readiness.

Many EOs volunteer at local health organizations. Shirley Ogrysko maintains a list of EOs who offer room in their homes for victims of natural disasters. This list is also on file at the local emergency planning committees. The Collin quality video has been distributed to over 50 companies and is available through the Institute of Industrial Engineers (IIE) catalogue. Some other key community support activities in which EOs and leaders are involved are listed in Figure 1.2-2.

Community Area	EO(s)	Description of Activity Involvement
Education	EOs	Quality learning and application at K-12 schools
	Executive staff	MBA presentations at regional and state universities (U.S. & Japan)
	Managers, executives	Principal replacement day
	IS EOs	Wired local grade schools and high schools for Internet access
Government	CEO	Presentation on application of TQM in government
	Quality Manager (Japan)	Worked with local government to repair roads around city of Koga
Health	EOs	United Way, Red Cross, Food for Needy, Koga Disaster Relief
	EOs	Free flu shots for community, free body fat analysis for community
General Support	CEO	Member, Board of Directors of the Institute of Printed Circuits
	Executives and EOs	Speakers and participants in the annual Tennessee Quality Expo
	Executives and EOs	Participated in the Consortium Quality Interchange
	EOs	Provided gifts for holiday programs

Figure 1.2-2 Community Support Activities

2 Strategic Planning

2.1 Strategy Development

2.1a The key milestone which marked the start of Collin's continuous improvement journey was the formal adoption of Collin's strategic planning process, the Perennial Planning Process (PPP), by all business segments. The PPP starts with a self-assessment against the Baldrige Criteria by each business segment, followed by various assessments of the world in which Collin's work force lives and works. This process is illustrated in Figure 2.1-1. It effectively combines all quality, customer, financial, market, human resource, supplier, and operational goals and ends up with realistic action plans. The major categories of input to the PPP and their owners are listed in Figure 2.1-2. Many sources of input are received throughout the year, ranging in frequency from monthly to annually. Instead of sponsoring an annual event to collect strategic input, Collin distributes input-generating activities throughout the year. In this way, inputs are supplied at a fairly constant rate compared to conventional batch input on an annual basis. The results of these assessments are collected quarterly for comparisons and trends. Results are reviewed by senior managers, who also identify long- and short-term goals and initiatives. The short-term issues are presented to the appropriate business segment for inclusion in their action plans. The Business Segment Managers are responsible for collecting and analyzing customer

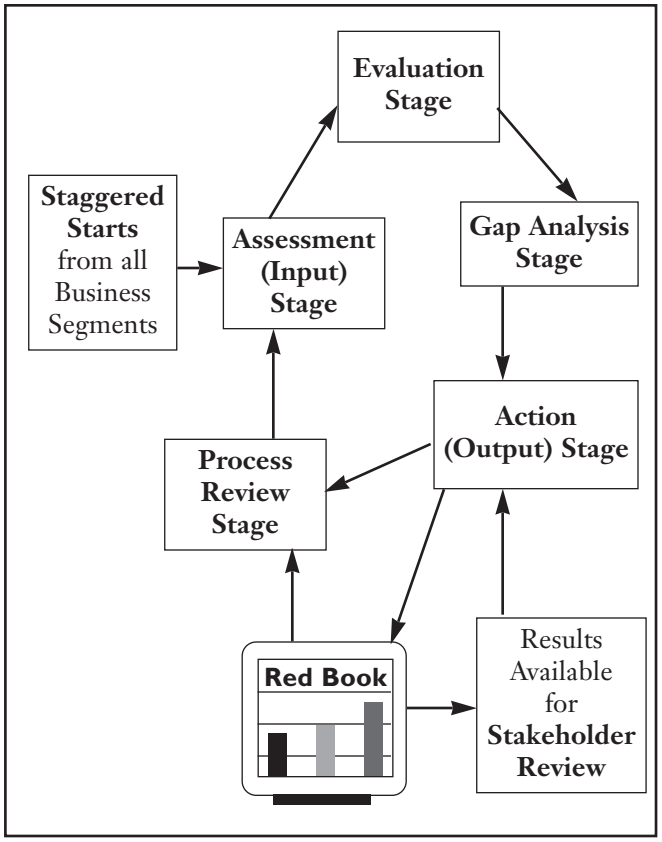

Figure 2.1-1 Collin's Perennial Planning Process (PPP)

Category of Input	Example(s)	Owner(s)	Plan Element(s) Affected
Customer Data	• Customer Surveys • Sales Coordinator Assessments	• Dir., Customer Support	Strategic Direction Product Development Process Management
Market Data	• Third-Party Assessments • Industry Sources	• Dir., Marketing and Sales • Bus. Segment Managers	Strategic Direction Product Development Technical Direction
Competitive Assessments	• Customer Surveys • Product Analyses • Sales Coordinator Assessments	• Dir., Customer Support • Dir., Marketing and Sales • Dir., Customer Support	Strategic Direction Product Development
Technology Assessment	• Annual Technology Assessment	• Chief Technical Officer	Product Development Technical Direction
Risks	• Meetings with Regulators • Safety Audits	• Chief Envir. Officer and Dir., EHS&S Services	Product Development Technical Direction
HR Capabilities	• HR Capabilities Assessment • EO Survey	• Dir., Human Development Services	Human Resource Capabilities
Operational Capabilities	• Baldrige Assessments • ISO Compliance Audits • Performance Analyses	• Dir., Cont. Proc. Improvement • ISO Management Rep. • Chief Operating Officer	Process Management
Supplier Capabilities	• Supplier Ratings	• Production Directors	Product Development

Figure 2.1-2 Inputs to the PPP

and industry data for each business segment. The long-term issues are incorporated by senior management into the company's Strategic Business Plan (SBP).

The SBP is divided into five elements listed in Figure 2.1-2. These elements are developed by the products generated by one or more of their respective inputs. Each element incorporates concerns of all stakeholders and is focused on answering a key strategic question. These elements and their related questions are:

- *Strategic Direction* — What does Collin have to do to maintain industry leadership in the global marketplace?
- *Product Development* — Is Collin designing and producing the right products to maintain the lead supplier role for its customers?
- *Process Management* — What are Collin's key processes, and is Collin managing them to support its leadership role?
- *Technical Direction* — Is Collin pursuing the best technologies to develop products in a reliable and environmentally responsible manner?
- *Human Resource Capabilities* — Is Collin incorporating the appropriate training to enhance the knowledge base of the work force to support automation and maintain industry leadership?

In the Action (Output) Stage of the PPP, Collin:

– Develops strategies;
– Updates strategic and action plans; and
– Monitors target goals.

The last category of outputs resulting from the Action (Output) Stage is the target goals, particularly those for the key Stakeholder Teams. This provides stakeholders with the opportunity to compare results with goals, redirect efforts to reach those goals, and identify areas to develop new processes.

In its routine, continuous use of PPP, Collin uses formal assessment vehicles, face-to-face interviews, telephone conversations, third-party assessments, and professional society and social gatherings to obtain valuable strategic and tactical information. The PPP provides the format and process to facilitate collection and analysis of this information and implementation of the necessary actions. All inputs are entered directly in the Planning Server. PPP reviews are conducted by senior management and process teams on a quarterly basis to monitor progress and alignment with strategic goals. The Leadership Team reviews progress and the alignment of the PPP in its off-site meeting held every six months.

The PPP invites input from **customers** from a number of other sources: some of these include the Baldrige assessment, market surveys, customer satisfaction surveys, and sales coordinator assessments. Along with other inputs, customer input is collected and integrated in the Collin Advanced Integrated Network (CAIN). CAIN also prepares a reminder if a stakeholder has not provided input over the past quarter. Input from a large number of additional external sources, including industry and professional societies, government agencies, and independent third-party analysts, is incorporated into the PPP. When customers enter a business relationship with Collin, they are greeted up front with an approach that invites them to participate in a strategic sense with the company. The process owners (Michelle Blanton, Theresa Gomez, Sammi Tynes, and Bob Yacobi) explain to customers their hope of nurturing a long-term relationship and describe the assessment regimen; they then develop a schedule for assessment activities which is acceptable to all participants. The Baldrige self-assessment is conducted on a continual basis, with the company conducting at least one team survey per month across all business units at both sites. Customers, along with preferred suppliers and all stakeholders, are invited to join Collin's assessment teams so that their requirements are included in the resulting strategic initiatives and action plans. Collin lets them provide guidance on their requirements and also develops a sense of the expectations of their end customers. These assessments are conducted in a networked environment that provides real-time results. Market and sales coordinator assessments and customer satisfaction surveys are conducted electronically with web-enabled software over Collin's Intranet. Based upon recent findings, customer requirements are summarized in Figure 3.1-1.

Similar to customer assessments, analyses of the **competitive environment** are also accomplished during the Baldrige assessments, market surveys, customer satisfaction surveys, and sales coordinator assessments. From a competitive perspective, people who participate in these surveys are also involved in the civic, business, government, and technical communities related to Collin's industry. They bring their rich knowledge from these external relationships into the appropriate assessments and survey vehicles. In addition, the involvement of customers and preferred suppliers in these assessments provides another rich source of competitive data and information about expected technological changes. Sales coordinator assessments provide similar data points. Collin's market, customer, and employee satisfaction surveys include direct questions comparing its performance, products, and services with the competitions'

offerings. Collin reinforces its competitive advantage by hiring the best talent in the industry and using outstanding employment practices. Collin annually commissions an independent study to review state-of-the-art technology in its industry and to evaluate competitive threats. The company benchmarks best-in-class products and service quality, not only against its competitors, but relative to its customers' "best suppliers." Collin uses these analyses to identify competitive gaps and closure rates to set short- and long-term product, technology, and quality goals.

A comprehensive analysis of risks is key to helping company leadership identify the strategies necessary to excel in a very competitive market. Financial, societal, and potential risks are issues specifically addressed in Baldrige assessments. In addition, these and similar risks are identified, and their potential impact on Collin is evaluated during market surveys and sales coordinator assessments. Issues identified as potential risks are synthesized into a specific report for review by the Leadership Team on a quarterly basis, or more frequently if conditions dictate. The Leadership Team then assigns action items based on these risks to the appropriate teams. Benchmark data are used in these reviews to evaluate risks in setting goals and priorities.

To help its EOs become the "best" knowledge-based work force in the industry, Collin identified necessary **human resource capabilities** to integrate the work force with automation and put and keep the company and its EOs in the forefront. For each assessment vehicle Collin uses market, industry, and third-party assessments to evaluate the capabilities in which the company needs to excel. Collin relates those capabilities to the needs EOs indicate they have to provide or support the necessary capability. (See Figure 2.1-2 for human resource capabilities among the other four strategic elements.) Whenever a new or improved capability is identified, the direct involvement of Vincent Daubert, Shirley Ogrysko, Richard Floss, and the appropriate technical discipline is invited. Human resource capabilities are routinely assessed through market and industry surveys, and Baldrige assessments.

The ability of Collin to perform well, identify future **operational capabilities and needs**, align resources to those needs, and meet new business and technical challenges is analyzed during Baldrige and ISO compliance assessments, as well as during ongoing reviews of internal operations data. Since the ISO program incorporates a futuristic view along with the "as-is" review, it has become a valuable tool in assessing whether Collin has the best processes documented and in practice. The Baldrige assessment enables Collin to improve its overall performance management system.

Major material suppliers help with design tradeoffs and new technologies during Collin's planning and goal setting. As a small company, Collin supplements its developmental capability with the strong research and development (R&D) skills and other industry-related **capabilities and needs of its preferred suppliers.** The company also relies on the capabilities of service suppliers, such as insurance companies, government agencies (e.g., OSHA, EPA, EEOC), and an accounting firm, to provide help in identifying needs, developing short- and long-term goals, and making improvements in their specialty areas. Sales coordinators, who are involved with customers daily, provide another valuable source of information. They are close to the marketplace and act as listening posts for information on product and service expectations, and technological advances. International sales coordinators also bring a unique perspective on the needs and culture of Collin's international customers. The valuable information which sales coordinators learn on behalf of Collin is channeled into the PPP through the sales coordinator assessments (Figure 2.1-2).

2.1b Key strategic objectives are formulated from a compilation of strengths and opportunities for improvement identified during the Evaluation Stage of the PPP; the outputs from this Evaluation Stage then feed the Gap Analysis and Action Stages. Capabilities and needs of the internal and external stakeholders participating in the assessments, analyses, interviews, and studies are integrated. Common issues are combined, and the resulting objectives formalized into the Strategic Business Plan (SBP) that assigns team ownership, implementation schedules, and reporting plans. To minimize the use of paper-based records, customized programs facilitate the collection and integration of important elements of this planning process for all participants. For data-intense input, analysis is carried out by sophisticated forecasting algorithms. Eight of Collin's 12 key strategic objectives and goals for the next 3-5 years are shown in Figure 2.1-3. Final judgment on the strategies that are most beneficial to stakeholders and Collin rests in the hands of the Leadership Team, combined with process owners and team leaders. As described in Item 1.1, the Leadership Team is responsible for balancing the needs of all stakeholders. Collin clearly recognizes that for the company to grow, Collin needs to support as well as seek support from each stakeholder identified in Item 1.2, including its civic, business, and professional communities.

Owner	Inputs	Objective	Goal
Sammi Tynes	Customer Satisfaction Survey	Shorten cycle time by 5% per year	25% total by 2004
Theresa Gomez	Market Survey	Improve on-time delivery by 5% per year	20% total by 2003
Michelle Blanton	Baldrige Assessment	Help customers and preferred suppliers achieve Y2K compliance	Completion by end of calendar 1999
Jeff Mercier	ISO Compliance Assessment	Obtain approval as ISO 9001 compliant to upcoming Year 2000 update	Compliance at the Tennessee facility in January 2001, at the Koga plant by 2002
Fred Fischer	Government Sources	Obtain approval as ISO 14000 compliant	Compliance at the Tennessee facility by June 1999, at the Koga plant by 2001
Paul McNulty	Internal Operations Assessment	Achieve Y2K compliance corporate-wide	Completion by 2nd Quarter 1999
Georgio Michelli	Internal Operations Assessment	Reduce product cost by 1% per year	5% total reduction by 2004
Frank Malone Andy Waterman	Industry Sources	Increase number of preferred suppliers by 5 per year	Achieve 70 total by 2003

Figure 2.1-3 Key Strategic Objectives and Goals (Sample)

2.2 Strategy Deployment

Collin's Strategic Business Plan (SBP) and action plans continue to evolve throughout the year; both are analyzed on a quarterly basis. Because Collin is small, one way to deal with major events, such as shifts in strategic direction, is to distribute the impact over time; this is accomplished by applying the PPP as a continuous, routine process. This approach allows Collin to dedicate rare and necessary resources over a gradual time frame, using the right people and talents at only the appropriate times. To maintain and improve its position in the market, Collin continually improves in all phases of its business as well as maintains technical leadership. These factors are combined with cost performance improvements to maintain the level of customer and stakeholder expectations. Collin's principal plan for success is long-term sustained continuous improvement.

To ensure that the PPP is routinely reviewed to identify process improvements and opportunities for streamlining, a built-in review process is conducted as part of the quarterly reviews. The Leadership Team maintains oversight to ensure consistency and deployability through process implementation and among the periodic review cycles.

2.2a The Assessment Stage of the PPP is fed by inputs from numerous sources. The outputs from this stage enable Collin to identify strengths and opportunities for improvement, gaps between performance and necessary strategic focus, and strategic objectives and goals (Figure 2.1-3). Short-term goals are documented in the business segment action plans, and long-term goals are collected in the SBP (Figure 2.1-1). This information is available to stakeholders in the Red Book, which is Collin's electronic ledger of performance metrics.

Each of the action plans lists specifically what resources are required in the categories of space, equipment, technology, and people, with the people category grouped by skill levels and necessary improvements in those skills. All of these goals are recorded in the Red Book (Figure 2.1-1), which is regularly reviewed by senior management and is available for review by all EOs, customers, and preferred suppliers. Essentially, the Red Book is an electronic version of Collin's performance scoreboard. Business segment goals are reviewed at periodic meetings and during individual performance reviews. Company goals and alignment of action plans are reviewed monthly by senior management, and both successes and opportunities for improvement are identified and recycled into the review process as necessary (Figures 2.1-1). Senior managers do the same for their business segments' performance. The primary reason for this frequent review is Collin must be able to review and redirect resources, if necessary, in very short time frames. Cross-business segment factors, such as human resource issues, green manufacturing, and computer hardware/software issues, are reviewed for alignment

Goal	1991	1993	1996	1999	Sample Results Figures	Leadership Team Owners
On-Time Delivery	+12%	+15%	+18%	+25%	7.1-7	Theresa Gomez
Unit Price	–5%	+1%	+5%	+20%	7.5-10	Georgio Michelli
Development Cycle	0%	+1%	+10%	+30%	7.5-11	Bob Smythe
Employee Satisfaction	0%	+3%	+6%	+10%	7.3-1, 7.3-2	Richard Floss
Growth Support	+1%	+30%	+45%	+60%	7.2-8	Paul McNulty
Customer Satisfaction Results	+1%	+2%	+7%	+10%	7.1-1	Sammi Tynes

Figure 2.2-1 Comparative Performance

– = Worse than Best Competitor
+ = Better than Best Competitor

across business segment action plans by the appropriate functional managers. If alignment becomes an issue, these managers may convene a team meeting to focus on specific issues and develop necessary guidelines or point papers. Key processes are documented and fully implemented as verified every six months by the ISO registrar. Collin has not received one major finding since it achieved approval as ISO 9001 compliant in 1997.

2.2b Collin fully expects that its competitors are developing similar objectives for improvement. However, customers indicate that Collin leads the competition in all important quality areas, including response time, delivery, performance, and reliability. Despite Collin's price reduction initiative, the sole opportunity for it to improve is in unit pricing where competitors have aggressively tried to penetrate its markets. Collin has not compromised its superior service and product performance in its continuing efforts to decrease prices. Pricing improvement initiatives are having a positive impact in reducing costs and will allow Collin to continue its leadership position on price in the near future. Collin plans to "raise the benchmark" by continuously increasing the performance standards its competitors must reach. Figure 2.2-1 shows Collin's performance goals in relation to the best of its competition and where Collin expects to be in 1999. This information is gained through market and industry assessments and sales coordinator assessments. This projection will require continued improvements in all of Collin's functions.

Figure 2.1-3 identifies strategic objectives and goals through year 2004 by key input. All related measurements have been identified as either leading or lagging measures (Figure 4.1-1). Actual results for key measures have been integrated into the Balanced Scorecard (Figure 4.2-2). Collin gathers competitive assessment data from customers, suppliers, sales coordinators, and industry associations, and through participation in professional, business, regulatory, and civic organizations. Competitive and benchmark data are shown throughout Category 7 results for financial, market, and available product data. Collin has been in the forefront in both developing and tracking technological innovation.

Additionally, Collin uses internally generated data to compare the results of operations between business segments as well as between manufacturing sites. Figures 7.2-13 and 7.2-15 provide examples of how data are segmented to evaluate and improve internal operations between segments. Figure 7.2-13 is particularly pertinent since it demonstrates that Collin is concerned with keeping its products in the growth stages by incorporating innovation and future technologies. Results and improvements are shared with all EOs through the Red Book (Figure 2.1-1) and during quarterly meetings. Employee ownership has served to increase continuing interest in producing the correct results.

3 Customer and Market Focus

3.1 Customer and Market Knowledge

3.1a Collin currently serves four specialized segments in the overall printed circuit board market defined by product functionality and use, customer requirements, and benefits. Important functional characteristics of Collin's products are their multiple layers, advanced materials, high component density, and very fine lines and spacing. Its products are typically used in very demanding environments and are integrated into customers' products. Customers choose Collin because of its high quality and reliability, fast technical response, consistent on-time/just-in-time (JIT) delivery, and focus on customer service. For example, on-time/just-in-time delivery creates a "virtual warehouse" for customers at Collin's site. By working closely with customers from product design to reorder, Collin's experienced design and customer support staff become a "virtual work force" to save customers money and to enhance relationships.

Segmentation is based on market data collected from current customers, customers of competitors, and potential customers and markets. Collin begins the segmentation process at the global level by determining the factors and trends that drive customer requirements. It uses market intelligence data gathered throughout the year as part of the Perennial Planning Process (PPP). Business Segment Managers use this information to forecast opportunities within each geographic area and to define segment requirements. Then they analyze existing customer data by segment using Collin's customer database and customer surveys. Results of these analyses are used as inputs to the PPP and to design product and service offerings.

Collin's business is organized to satisfy the needs of its four key segments (Figure 3.1-1): Commercial (C), Government (G), Industrial Products (I), and Advanced Technology (A). **Government** customers use Collin's products in defense and research programs that require small quantities of highly reliable products. **Commercial** customers integrate Collin's products into their products; they want fast turnaround and competitive prices. **Advanced Technology** customers deploy Collin's products under extreme environmental conditions; they order smaller quantities of very robust products for harsh environments. **Industrial Products** customers use Collin's products in internal process control manufacturing applications; they want high reliability products for demanding conditions.

Collin determines customer requirements and expectations via multiple listening posts deployed at key points throughout the customer life cycle and information obtained through independent external sources. EOs follow up with customers to verify performance on current orders, determine repurchase intentions, and seek new business opportunities. Collin deploys a wide choice of mechanisms that make it easy for customers to communicate with the company.

Requirements	Segment			
High Quality	C	G	I	A
High Reliability		G	I	A
On-Time Delivery	C		I	
Short Delivery Time	C		I	
Competitive Price	C		I	
Rapid Response			I	
Cutting-Edge Technology	C	G		A
Stable Dimensions		G	I	A

Figure 3.1-1 Customer Requirements by Segment

Customer Satisfaction Survey ratings generate quantitative measurements on product performance versus current requirements, relative importance, priorities, and relative level of interest in new offerings. Collin combines this post-transaction information with Baldrige self-assessments to overlay evolving customer needs against company capability assessments. It aggregates customer data by segment to discern segment trends, detect shifts in segmentation variables, and project future segment opportunities (Item 3.2).

Customer focus groups verify the data gathered through Collin's field listening mechanisms and seek customer perspectives on changing requirements and potential customers by segment. These results are part of the inputs to the PPP. Collin reviews short- and long-term product strategies with customers to learn how well plans address current and emerging requirements.

Collin monitors competitor activities by studying how (buyer selection) and why (vendor preference) it is selected by customers over other vendors. Collin tracks the number of customers that leave, why they leave, where they go, and the amount of lost revenue to understand the strength of the competition. In addition, Collin uses data from a cross-section of non-customers to understand why companies choose other vendors. These analyses enable Collin to offer broader product and service lines than competitors.

A cross-section of EOs participate in Collin's industry, supplier, and customer seminars, groups, and conferences to understand *their* industries and to obtain information on changing industry, segment, and customer requirements. At trade shows, Collin conducts market interest surveys to gather information from customers of competitors and other potential customers. Industry publications help Collin calibrate strategic direction,

anticipate competitive responses, and identify evolving opportunities. It commissions independent market and segment studies and merges these data with internal accounting, marketing, preferred supplier, sales coordinator, customer satisfaction, and complaint data to create ongoing competitive scenarios.

Quarterly, Business Segment Managers collect, analyze, and review the customer, competitive analysis, and industry data and incorporate these inputs in the PPP.

Through reciprocal partnering agreements, Collin participates in customer strategic planning processes as key suppliers, just as customers participate in Collin's PPP (Item 2.1). Most opportunities for innovation arise in the Commercial and Advanced Technology segments, where there is significant participation by Collin in customer strategic planning and on customer design teams. Customer and supplier participation on Baldrige-based assessment teams (Item 2.1) provides ongoing customer input on the relative importance of product and service features and how Collin can best address these requirements.

The limit defining the slope of the learning (cost leadership) curve for addressing future customer requirements is the cycle time for incorporating technological advances in the design and manufacture of new products. Manufacturing technology innovators come to Collin to test, refine, and develop their ideas. As new technologies are studied, Collin uses customer requirement data to identify customers who would most likely benefit from incorporating these breakthroughs in their current and future products. Collin's reputation as the manufacturer of technically sophisticated products attracts demanding customers who seek its advice on how to address their advanced technical requirements and to create prototypes. Collin's process laboratory (Item 6.1) develops new technologies and runs prototypes for use in customers' research and development activities.

Annually, Business Segment Managers review listening methods, their deployment, and the learning process. They assess and update survey instruments to ensure questions address changing company capabilities and customer requirements. They review listening and learning data and analysis processes to determine procedural changes and select new data collection mechanisms to improve the effectiveness of the approach. These reviews have provided several refinements in Collin's approach. For example, satisfaction surveys are deployed throughout the year rather than once a year. This approach, implemented by benchmarking a similar-sized, mid-range computer distributor identified through the Consulting Best Practices Program, has improved efficiency, turnarounds, response rates, currency of data, and customer satisfaction with the satisfaction measurement process. Also, it has provided Collin with many program expansion capabilities.

3.2 Customer Satisfaction and Relationships

3.2a Sales coordinators are assigned to each customer to create a focused and consistent personal point of contact between Collin and the customer. A subset of these sales coordinators, known as international sales coordinators, is assigned to Collin customers in Europe and Asia. As described in the Business Overview, they are recruited from these regions to ensure their familiarity with local languages and customs. Even though they are based in Nashville and Koga, their work schedules are established to accommodate the needs of their customers.

Collin uses a variety of methods to transmit information to customers and for customers to seek assistance, conduct business, express satisfaction, or voice complaints. Major technologies include Collin's Internet site, workstations, and personal data assistants with e-mail, voicemail, paging, data exchange capabilities, and direct high-speed Electronic Data Interchange (EDI) connections with customers via CAIN.

Customer Contact EOs (CCEs) use CAIN to log and track all customer interactions. When customers or EOs enter the customer's access code, CAIN logs the contact and displays historical customer data so that all EOs have complete access to the customer's full history and current status. Collin is the only vendor in its market with the capability to readily access information while recording data for aggregated companywide analysis.

CCE Teams define and improve specific customer contact requirements, service standards, and goals for each type of interaction based on direct input from customers, Customer Satisfaction Survey ratings and comments, customer feedback, and benchmarks. Although customer service requirements vary by segment, Collin sets uniform companywide customer service standards based on the requirements of the most demanding segment. Quarterly, CCEs use these inputs to evaluate customer service performance standards, goals, and measurements to ensure they are current with customer needs and business capabilities. Figure 3.2-1 provides examples of customer service standards.

Customer service standards are deployed through team and individual performance plans. Team and individual performance objectives are set for each service standard based on overall company performance standards and annual improvement goals (Item 5.1). EOs receive immediate feedback on their performance to standards through CAIN, which tracks each contact, its duration, and the outcomes, and displays statistics for each CCE,

Performance Requirement	Standard
Follow up new customers	Within 3 days
Survey new customers	Within 30 days
Follow up lost business	Within 3 days
Customer access on first call	100%
Follow up complaints	Same business day
Resolve complaints	Customer's satisfaction

Figure 3.2-1 Examples of Customer Service Standards

department, and the company on demand. CCE Teams review team performance results versus goals by segment weekly. Business Segment Managers advise CCE Teams on improvement actions to ensure actions address companywide customer service performance goals.

Collin trains CCEs, field personnel, and managers to use the CAIN complaint form to document all formal or informal customer complaints. A user can "hot key" to this screen from any location in CAIN. The system fills in current customer information upon execution. The EO verifies (or updates) this information and logs the complaint. The information needed to understand a customer's complaint is available to the CCEs as they log it. When a complaint is logged, CAIN instantly routes the complaint to the appropriate sales coordinator for follow-up and resolution and forwards a tickler to the appropriate Business Segment Manager and Customer Stakeholder Team leader. CAIN reminds parties each time they log on the system that the complaint is "open" and displays its status versus customer service standards to ensure prompt corrective action. Collin requires that all complaints be resolved through direct personal contact with the customer who initiated the complaint or with the person the customer designates. Complaints are considered resolved when customers confirm that they are satisfied with the resolution. If this cannot be achieved, there are escalation procedures to involve additional resources as required. First-level CCEs use these procedures whenever they feel they cannot resolve the issue within 24 hours to the customer's satisfaction at their level. Escalation rules are based on complaint codes. Collin codes complaints by symptom or problem experienced (as described by the customer), general cause (based on a detailed analysis of prior complaints), and root cause (based on a detailed analysis of the problem). This approach ensures that appropriate resources are involved in the resolution process. Complaint codes are consistent with other coding systems used to organize data collected throughout the customer relationship life cycle, such as Customer Satisfaction Surveys and customer requirements research, and with internal quality data, such as internal rejects and warranty claims. This approach enables Collin to correlate product performance data from customers with internal quality assessment data to identify the scope and magnitude of customer problems, verify the effectiveness of job performance and corrective actions, and estimate the financial implications of inaction or resolution. Collin verifies the effectiveness of resolution through follow-up calls and surveys that focus on satisfaction with the timelines and resolution it promised. Sales coordinators verify that complaints are coded by type for later Pareto analysis. CAIN provides data on response time by all EOs involved in the resolution process. These data are aggregated, and the Business Segment Manager presents the data to process teams for evaluation, verification, corrective actions, and process improvement. Results of complaint reviews and process improvements are published to EOs via e-mail. CAIN files are updated with the complaint resolution results to provide information for future root cause analysis.

Collin has partnerships with key customers who rely on the high value of products delivered on time with stringent quality and JIT requirements. Relationship building is embedded in all business processes from initial customer contact to the follow-up after the latest order.

Collin assigns a Business Segment Manager to each customer segment to better understand the unique characteristics and specific requirements and expectations of that segment. Sales coordinators are assigned to specific customers with similar characteristics in each segment. The Business Segment Manager and sales coordinator structure makes Collin an integral communications and coordination link among different units of its customers' business processes.

Customers are included in each new product design review stage to better understand customer needs, develop and communicate mutually acceptable expectations, and improve business relationships. When developing a new product, the sales coordinator creates a cross-functional team that includes customer representatives. Collin incorporates design changes as the customer or Collin engineers provide input to the design database. Overnight carriers deliver customer prototypes reflecting these changes the next day. History and current status of customer relationships are included in CAIN to ensure rapid, accurate data in a form that EOs can use to make timely empowered decisions. Customers participate on Collin's Baldrige-based assessment teams (Item 2.1). This enables Collin to ensure that its requirements and end users' expectations are included in strategic initiatives and action plans. This approach also enhances the longevity of relationships, facilitates repeat business and positive referrals, and

helps keep Collin's relationship approaches current with customer expectations. Annually, Business Segment Managers evaluate and improve customer relationship management processes by reviewing survey results and performance measurement results. Formal (e.g., survey results and focus groups) and informal (e.g., comments and field contacts) customer feedback is sought on which methods of customer access, contact management, and relationship building are meeting customer needs. Collin compares performance results to goals for each mechanism to verify implementation. Assessment outcomes are distributed to all EOs involved in each approach so corrective actions can be implemented. The effectiveness of new methods or process improvements is monitored during future evaluation cycles.

3.2b Collin monitors customer satisfaction and dissatisfaction through internal and external independent surveys and uses competitive comparisons and appropriate benchmarks consistent with the business model. Collin's internally generated Customer Satisfaction Survey uses a standardized Likert semantic differential rating scale ranging from Very Satisfied ("5") to Very Dissatisfied ("1") for the general and specific performance factors based on segmentation attributes and customer requirements. Customers use the same scale to rate the importance of each attribute, their satisfaction with Collin's performance, and their satisfaction with Collin's performance compared to other multilayer board manufacturers for each attribute. CAIN administers surveys to customers as they transact business on-line. These surveys are based on a sampling profile that ensures that every customer is surveyed. Also, each segment is surveyed every trimester with approximately equal response rates to ensure the validity of data comparisons over time and among segments.

Critical performance attributes have been determined over the years via market research based on a combination of quantitative and qualitative research techniques, including in-depth interviews, focus groups, and mail and telephone surveys. Collin identifies critical performance factors through factor analysis and discriminant analysis. Factor analysis divides survey data into the underlying dimensions and selects attributes that accurately measure each dimension (validity). Discriminant analysis determines if the selected performance attributes are accurate predictors of overall satisfaction and dissatisfaction (reliability and correlation). Several iterations of these analyses have yielded attributes that are statistically valid and correlated. This enables the company to capture actionable information to predict future customer behaviors and/or tendency for positive referral. Although Collin uses the same survey methods and scale for all customer groups and market segments, it uses different attributes for different segments, based on a refinement of requirements derived from these statistical approaches (Figure 3.2-2). This enables Collin to more accurately measure and predict likely market behavior by segment.

Satisfaction Attribute	Segments			
Product Quality, Warranty	C	G	I	A
Product Design, Reliability		G	I	A
Conformance to Specifications		G	I	A
Courtesy, Access, Communications	C	G	I	A
Customer Service Responsiveness	C	G	I	A
Complaint Resolution	C	G	I	A
Rapid Response, Turn Around	C		I	
On-Time Delivery	C		I	
Features, Benefits, Value-Price	C		I	
Reputation, Competence	C		I	A

Figure 3.2-2 Customer Satisfaction Attributes by Segment

Collin surveys multiple contact points within the customer organization (i.e., Purchasing, Quality, Engineering, and Manufacturing) to increase the objectivity and reliability of data. Surveys are coded by customer function to cross-tabulate data and evaluate performance in each area.

Collin's Satisfaction Improvement Tool Kit helps identify areas where improving satisfaction will produce the most significant change in results. The Tool Kit includes gap analysis tables, scatter diagrams, trend analysis graphs, and Pareto charts. Collin calculates the descriptive percentages for every combination of ratings to determine basic dissatisfiers, reward/penalty factors, and value-add factors. Plotting rating percentages over time demonstrates where improvements have been effective and where additional emphasis is necessary. Statistical methods determine if significant changes have occurred from previous periods. Statistical quality control limits highlight areas where significant trends are occurring. Correlations between the ratings of individual attributes and overall importance and the satisfaction ratings for each customer and each segment indicate customer priorities. Statistical inference tools identify the most relevant satisfaction attributes (satisfiers and dissatisfiers) driving customer satisfaction, preference, and loyalty.

EOs review the Customer Satisfaction Survey results via CAIN. Internally, the company monitors key customer satisfaction indices that affect the customer's perception of the company. These indices are updated monthly. The Leadership Team meets with all managers to discuss how their area is rated and what they can do to

improve before the next survey. Managers are accountable for taking necessary actions to improve ratings for their areas.

Customers set their service preferences through Collin's annual Customer Benchmark Survey. Performance standards and performance to standard are presented to a focus group comprised of a representative sample of customers who are asked to assess the effectiveness of the standard in providing the level of performance they desire. In addition to providing benchmarks for service standards, the group prioritizes the products and services that they consider important to Collin's business relationship. For example, Collin's data analyses have prioritized the customer satisfaction attributes (Figure 3.2-2) by segment to aid in understanding customer requirements and to ensure that Collin captures key internal and external customer satisfaction data in its customer surveys.

Sales coordinators follow up by e-mail, fax, or telephone within 24 hours of a shipment or quotation to ensure that customer requirements are met. In addition, they solicit and record customer perceptions on recent products, services, and recent transactions during their interactions to receive firsthand information and to promptly identify actionable opportunities for improvement. When a product is shipped, CAIN automatically issues a shipping notice to the customer and creates a tickler note for the appropriate sales coordinator to follow up with the customer. A tickler to the customer asks them to log on to CAIN to complete a transactional satisfaction survey. When sales coordinators log onto CAIN, their first screen is a list of customers who have not completed the survey and open tickler notes. When the contact and the survey results are recorded in CAIN, the note is removed, and the date, time, and person clearing the note are recorded. An automatic tickler to the Business Segment Manager ensures that follow up time does not exceed service standards. Less than "satisfied" ratings or negative comments automatically invoke complaint resolution procedures (Item 3.2).

Sales personnel follow up on all orders to verify satisfaction results (Item 3.1). Collin follows up on lost business opportunities with existing and potential customers to determine reasons it lost that business. These data allow Collin to focus current and future offerings on specific buyer selection criteria and improve win/loss performance.

The Customer Satisfaction Survey asks customers to rate Collin (using a consistent scale) against other multilayer board manufacturers on the key product and service attributes and relationship attributes it uses to define market segments and customer requirements. Collin correlates subjective customer perceptions with objective behavior-based marketplace measurements (Figure 3.2-3) to validate customer opinions with likely buying, referral, and loyalty behavior. This analysis is used in the PPP to forecast future business scenarios (Figure 2.1-1). Collin assesses survey results against inputs on its relative competitive position from field and industry listening posts to place these data in context of current marketplace feedback. Mechanisms include frequent customer interaction and follow-up, customer focus groups, participation in industry and customer group meetings, market interest surveys at trade shows, and independent studies. Collin's objective is to develop quick, comprehensive surveys, using a meaningful scale, which accurately assess the satisfaction with the most important product, service, and relationship satisfaction attributes compared to competitors. Collin asks a representative sample of customers to review its surveys in detail, comment on the effectiveness of the questions and measurement scale, and make improvement suggestions. Then, prototype surveys are administered to carefully selected test groups to assess the time required to complete the survey and the clarity of the questions, scales, and format.

Measurement	Results Figure
Complaints Per Ten Thousand (Overall and By Segment)	7.1-3
New Business Quotation Success	7.1-4
Won/Lost Repeat Business	7.1-4
Market Share	7.2-14

Figure 3.2-3 Correlation Between Marketplace Measurements and Customer Satisfaction

To validate, verify, and refine ongoing internal customer satisfaction research, Collin commissions an independent survey through an industry research group using the same scale as the internal survey process. This survey covers all areas of the customer relationship and includes general questions on customer perceptions of company performance in all areas. Collin cross-correlates external customer satisfaction results to its most recent internally generated Customer Satisfaction Survey results to verify the accuracy and validity of the data and its reliability and sensitivity as predictors of satisfaction, preference, repeat purchase, loyalty, and positive referral.

Customer satisfaction teams use indices that show weak correlations or negative trends to identify improvements (i.e., improvements in the Customer Satisfaction Survey questions, addition of questions or another measurement category). Business Segment Managers review these inputs with subject matter experts to prioritize improvements to customer satisfaction scales, measurements, and procedures.

4 Information and Analysis

4.1 Measurement of Organizational Performance

Collin's ability to meet all stakeholder needs is dependent on its information and measurement system. Because customers today require unlimited flexibility, 100% on-time delivery, and the lowest total cost, it cannot allow inefficient processes, production delays, or uninformed, slow decision-making. Collin's information system is comprehensive, fast, and linked to all stakeholders. It provides decision-makers with user-friendly analysis tools to translate data into actionable decisions. This information process allows Collin to set and communicate goals, steer its plans, prevent delays, achieve best-in-class delivery, and measure performance, while being agile and flexible to meet the needs of stakeholders. Collin's information flow is shown in Figure 4.1-1.

4.1a As defined in Figure 4.1-1, the input from stakeholders and users is auto-segmented by CAIN into predictive and performance data, which are linked to plans, goals, and comparisons. The predictive data are directly linked to Collin goals and plans, which, in turn, provide inputs to the Perennial Planning Process (PPP) (Figure 2.1-1) and the Strategic Business Plan. Predictive data are also used to determine the leading PDR measures. These predictive (PDR) measures are then used to drive educational, training, and business direction decisions. The performance data are linked directly to comparisons and used for determining Collin's position relative to targets, competition, and best-in-class companies. Performance data are also used to determine the lagging OPR measures. These output measures are used to drive general day-to-day decisions. Key measures made up of both PDR and OPR results comprise a set of company-wide Balanced Scorecard Indicators called BSC. The BSC indicators are used by the Leadership Team, all departments, other teams, and "in limited format" by customers and suppliers to determine the overall health of Collin's business. By looking at these measures, Collin leaders determine if customers are satisfied, suppliers are performing, EOs are satisfied and motivated, schedules and commitments are met, quality levels are achieved, costs are maintained, and environmental compliance is in order. From the information provided to customers and suppliers (a limited version of the scorecard), they can

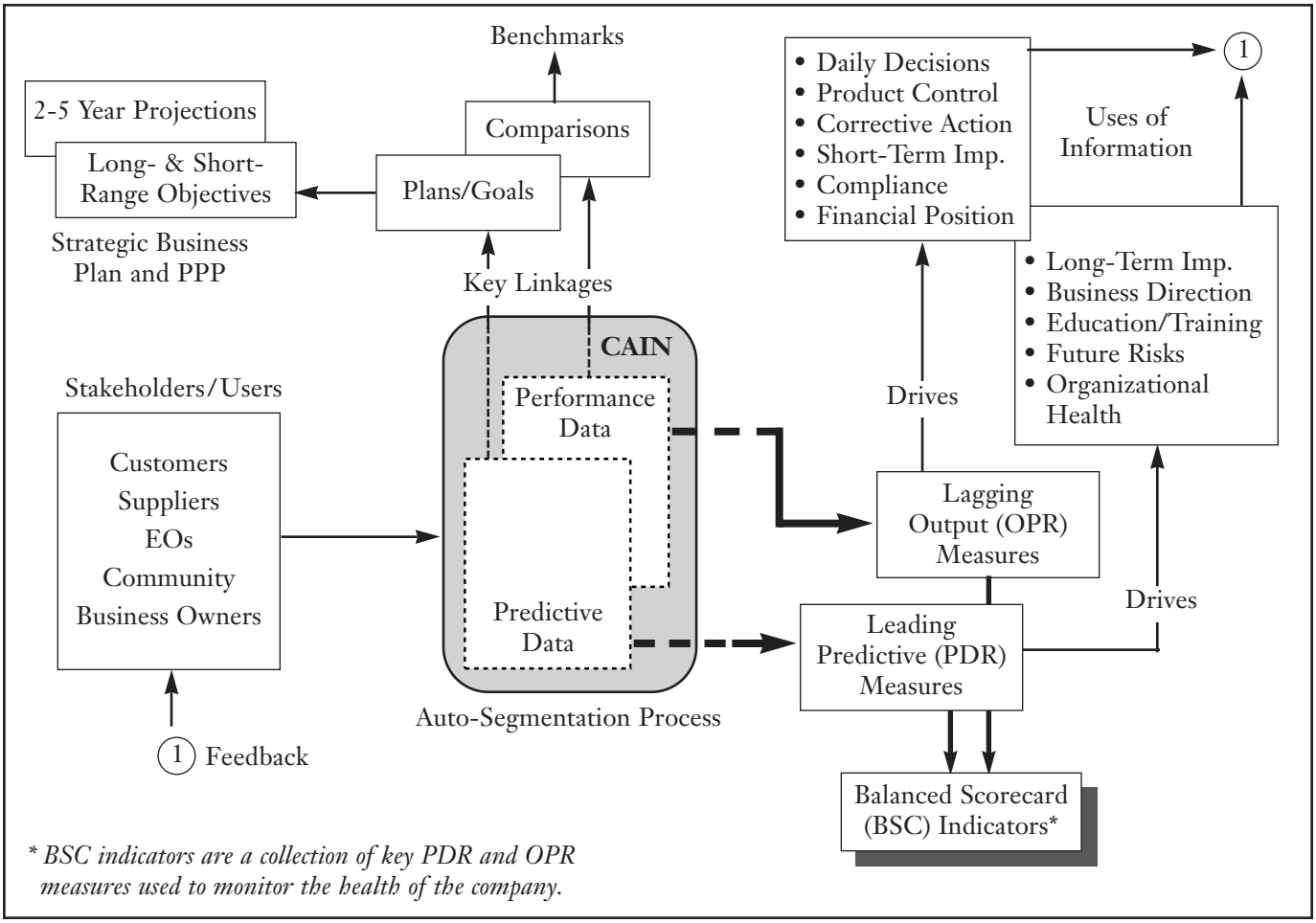

Figure 4.1-1 Information Flow

determine either how Collin meets customers' requests or how suppliers are performing to meet the needs of Collin and its customers. Strategically, the BSC lets the company know where it is relative to its long- and medium-range plans. In order for a measurement to become part of the BSC, it must meet specific criteria and be approved by the Leadership Team. The first criterion any BSC indicator must meet is whether it is a measure that drives cost, time, or quality. The second criterion is that the measure be either preventive in nature and link to an improvement strategy or of significant importance to the success of the business. How BSC measures are used to control and predict process behavior is described in Area 4.2a.

The BSC is one of the outputs of Collin's integrated information flow shown in Figure 4.1-1. Because the system is distributed, customers, suppliers, employees, and people within the community can input data into any server in the Collin network. The segmentation and analysis process interacts with all distributed servers and allows cross-analysis of data. Department managers, executives, teams, customers, and suppliers use this analysis process to inquire about status, identify opportunities for improvement, or control processes through an exception flag warning system. Based on the analysis of predictive and performance data, leading and lagging measures help track overall organizational performance (Figure 1.1-4). Collin tracks over 500 total indicators, but only a segment of these have been identified as BSC measures. Compared to the total number of company-wide lagging (OPR) measures, Collin tracks relatively few leading (PDR) indicators; however, most of the leading (PDR) measures have been identified as BSC indicators. The list of the leading BSC measures is provided in Figure 1.1-4. Figure 4.2-2 further shows how these indicators are integrated and link to overall organizational performance.

Collin's ability to meet its goals and stakeholder goals is the ultimate measure of its system's effectiveness. Collin tracks the performance data to compare or position itself relative to the competition and best-in-class companies. These data, in addition to being used for improvement, are also used to identify gaps among the competition, other role model companies, and Collin. Twice a year, the Benchmark Team, headed up by Sammi Tynes (Director, Customer Support), conducts research relative to all OPRs and presents a formal report to the Leadership Team. This information is also used as inputs to the PPP (Figure 2.1-1). The research is conducted with similar companies and with companies outside Collin's business. The team looks at known benchmark opportunities (International Benchmarking House, International Productivity Council, AEA, Baldrige Award recipients, etc.) as well as data from surveys, customer inputs, websites, and at least one randomly selected benchmarking consulting firm. All information is compared with existing reports and data gathered in the past to help identify best-in-class competitors and companies. As it identifies the best role model practices, Collin correlates existing performance data to similar data from those companies it considers best-in-class and, if a significant gap exists, a formal benchmark meeting is set up with best-in-class companies to compare practices. In this way, Collin determines opportunities for further improvement.

Reliable data are another key to Collin's information system. Whether data are collected manually, by machine, by voice, or by LAN, data need to be reliable and properly identified within the system to ensure that the best decisions are made. To ensure data integrity, Collin always provides the input with a source and date so that the originator can be contacted to clarify any suspect information. CAIN also auto-segments data into predictive or performance classifications. Most performance type data are initially analyzed automatically within the CAIN system by evaluating daily trends and built-in trigger points. Collin uses very few automatic analysis tools to review and further analyze raw predictive type data, because it has discovered automatic analysis tools are subject to fixed rules and sometimes lack the judgment needed to interpret the predictive type data. Predictive data are almost always analyzed through reviews of the overall data, relative comparisons, and benchmarks to Collin's OPR measures. Analysis teams work with both the raw data and the originators of the data to make it usable for further analysis. Single inputs are always looked at for supporting evidence (a practice learned from the U.S. National Press newspaper operation). Standard database system checks are also performed by Collin's computer information system. These include checks for duplicate inputs, range checks, and use of large file flags.

In addition to linking information to plans and goals, Collin further provides input to the PPP to help identify strategic short- and long-range objectives and 2-5 year business projections. In this way, leaders and managers have a tool to identify and act in a proactive way to meet current and future targets. By linking information to business results, all Collin managers have a direct way to identify cost impacts associated with their day-to-day processes. By using a combination of leading PDR measures and lagging OPR measures, Collin drives internal processes proactively while positioning itself externally to the business community. Both are needed to effectively manage the business.

Within the information flow (Figure 4.1-1), Collin has built a closed-loop feedback process. Through this process, information related to the operational health of the company is provided to all stakeholders. Collin also uses this loop to request needed changes to keep its system current with changing needs of stakeholders and the overall business. The semiannual benchmarking review looks at Collin's output measures compared to other companies to identify changes in these measures. Yearly, Collin conducts a survey about its information system. The company is looking specifically for better information gathering and analysis tools. Collin also participates in the annual "*Industry Review*" Best Information Systems (IS) Plants Competition to see how its system compares with information systems of businesses across the nation.

4.2 Analysis of Organizational Performance

4.2a The Leadership Team uses the subset of the leading and lagging indicators called the BSC to evaluate the overall health of the organization. Analysis of these BSC indicators is key to providing the Leadership Team with a clear picture of the overall health of the company and short-term company performance. This supports Collin's Core Values of becoming "better" at improving customers, EOs, suppliers, reinvestment and use of profits, and the community. As noted in Area 1.1a, Stakeholder Teams are designated as responsible to make this happen. They are also responsible to analyze relevant leading and lagging measures. Then they present both positive and negative results affecting the BSC measures to Candice Trobaugh and the Leadership Team during bimonthly performance review meetings. The process used to analyze BSC measures (Figure 4.2-1) is also used to analyze all results. It is a key element of Collin's Continuous Improvement Process (Figure 6.1-5).

The analysis process follows a "5-Step" analysis approach (center block of Figure 4.2-1). This process as applied to the BSC measures is as follows:

1. Both leading and lagging information measurement results are reviewed.
2. BSC OPR measures are compared to known comparisons provided by the Benchmark Team.
3. Gaps to short-term goals are identified.
4. PDR measures that are on track and that allow BSC OPRs to close short-term gaps are noted and labeled as Green.
5. PDR measures that are not on track and inhibit BSC OPRs from closing short-term gaps are noted and labeled as Red.

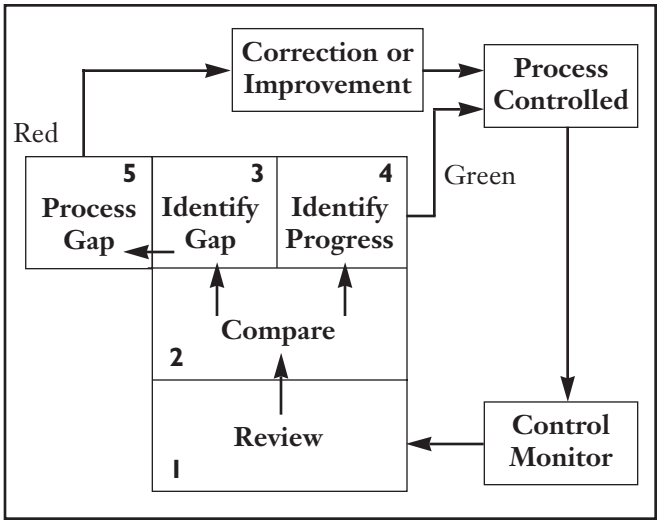

Figure 4.2-1 Collin's "5-Step" Analysis Process

Collin's Continuous Improvement Process is then utilized to identify actions for all "Red" PDR measures and bring them back to "Green" status. The same process is used for long-term or strategic goals. By depicting information in this way, areas that are operating well are clear as well as those needing additional support. As identified in Area 4.1a, lagging data and their associated measures are also used to control organizational-level performance. Their analysis is based on a combination of daily trend analysis by Collin EOs and automatic "action requesting" exception reports triggered by the CAIN system. When trigger settings are exceeded, a flag message is sent to the managers or team leaders responsible for the measure. This linkage of result to process ensures that functional-level decisions are based on factual data and trends. One example of how trend data are analyzed and translated into useful information at the operational level is as follows:

One of Collin's BSC indicators is the leading PDR measure of shipment linearity deviation, or Collin's ability to produce a product in a systematic way throughout the month to ensure that customers receive the product on time. The related OPR result tracked is on-time delivery performance (Figure 7.1-7, not currently identified as a BSC measure). The PDR measure tracked identifies the deviation from planned shipment. At the operational level, Collin tracks this as a leading indicator, but as a BSC indicator, it is sampled weekly and plotted as a monthly average. A trigger point is set within CAIN to notify management if the drift from plan exceeds 10%. (The trigger limit is based on one-half of the allowable upside capacity of 20%.) This allows decision-makers to use the excess capacity as a method to catch up when schedules slip. This exception flag warning system is a

last resort process because the information provided daily is predictive and, when watched, helps to prevent major drifts. Even when unexpected problems occur that trigger the system, Collin has a plan to get back on track before Collin's delivery schedules are impacted. Figure 7.5-7 shows Collin's ability to plan and execute to a planned schedule for the last five years. As noted previously, most lagging (OPR) measures are not BSC indicators, but are aligned with leading PDR measures. All BSC measures are aligned with OPR measures (Figure 1.1-4), thus showing what drives performance toward meeting plans and goals. In this way, there is a direct path from processes to benchmarks to Leadership Team reviews. The predictive type BSC measures are aligned to the plans and objectives of the company (Figure 4.1-1). They are then linked to appropriate OPR measures. This helps determine Collin's strategic position relative to the industry and the business community. Figure 4.2-2 shows this alignment.

As Collin increased its emphasis on process management and customers increased pressure to decrease product prices, the importance of the cost of each step in each key process also increased. As the Process Support Teams (PSTs) continued their investigations of manufacturing processes, the activities and resulting costs associated with each purchased part were found to represent the input cost prior to productive work by Collin's teams. The work that these teams add to the price of the finished product represents additional costs to be incorporated into the final price of each product. When this incremental production cost is added to the cost of purchased parts, and the sum is subtracted from the final price for which the product is sold to the customer, the resulting figure represents the value that Collin has added to the product.

Collin is just beginning to formulate an overall program for monitoring this value. However, three years' worth of data have been collected for products supplied to key market segments, and this information is available from CAIN. The results for typical boards for the Advanced Technologies and Commercial markets are shown in Figure 7.2-10. The Strategic Direction element of the PPP requires completion of this value-add initiative by mid-year 1999.

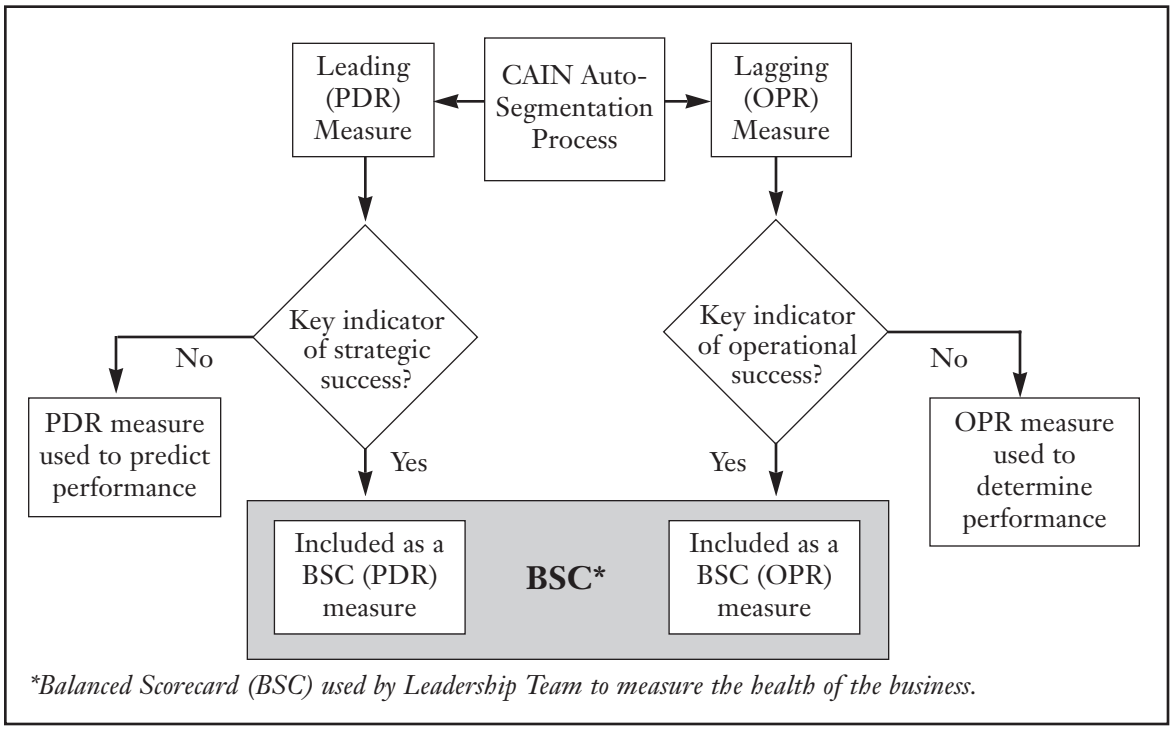

Figure 4.2-2 BSC Measure Alignment

5 Human Resource Focus

5.1 Work Systems

Collin's strength in the marketplace is driven by the motivation of its EOs and the team-based, prevention-oriented, and technology-driven culture that defines its workplace. Collin's Core Values (Figure 1.1-1), combined with its collaborative leadership system, provide the synergistic framework for its work environment. The motivation of its EOs is promoted by a system of achievement, recognition, work design, responsibility, and personal and professional growth.

5.1a In 1995, Collin was oriented toward a prevention-based quality management system structured around functional responsibilities and individual task assignments. Since then, the Leadership Team has shifted the focus to team-based activities that result in the achievement of the company's primary objectives as defined in the Core Values: (1) ever-improving products and processes; (2) growing careers for EOs; (3) more effective use of profits; (4) a better community; and (5) a mutually beneficial and learning relationship with customers and suppliers.

Because people make the achievement of these Core Values possible, the development of an innovative, professional, and results-oriented work force is a key ingredient to success. Vincent Daubert not only has the leadership responsibility for EOs and the Employee/Owner Stakeholder Team, he also chairs the responsive Human Resource Council (HRC), which oversees all functional aspects of the work system and EO support climate. Members of the HRC serve for one year and include two rotating members of the Leadership Team, four rotating team leaders, two sales coordinators, and two EOs who are randomly selected from all levels in the company. Candice Trobaugh provides point papers to the HRC on issues that she thinks need special attention; in addition, she often attends the meetings on an ad hoc basis. Also, membership includes representatives from the Koga facility, who participate fully during teleconferenced meetings.

The key issues facing the HRC are the following:

1. Are teams oriented toward the right products?
2. Are teams engaged in the right processes?
3. Are teams properly prepared to deal with the right products and processes?
4. What professional development is needed by the work force for future technologies?
5. Is the work force adequately prepared for leadership and management roles?
6. Are fair and equitable work force practices being conducted throughout the company?

The agenda for each meeting includes these topics, as well as issues that are introduced by HRC members. The structure of the work system is also under constant scrutiny to ensure that, despite Collin's small size, adequate challenges are presented to EOs, and career progression is available to deserving performers. Care is taken to ensure that the cultures of each location are appropriately addressed (Figure 5.1-1).

A primary benefit of the team structure is that it invites cooperation and collaboration both within and among teams. Strong team representation on the HRC helps provide the forum in which members of different teams can identify common issues which, when addressed between teams, provide Collin with improvements in effectiveness and efficiency. This approach invites the use of intuitive and innovative thought about the "how" and "why" of processes and provides a venue for a healthy review and dialogue about the human resource issues incorporated into Collin's work system.

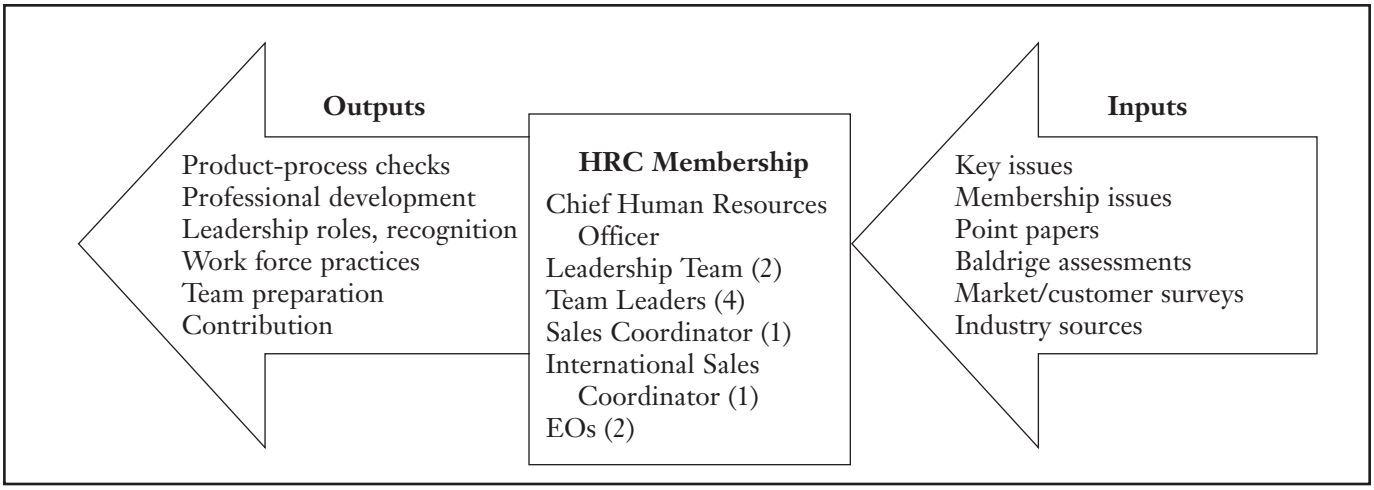

Figure 5.1-1 The Human Resource Council

Sales coordinator representation on the HRC is supplemented by the results of Baldrige assessments and market and customer surveys. Information from industry sources provides Collin with intelligence about changing technologies and industry trends which could impact the development needs of the work force.

Collin uses the PPP (Figure 2.1-1) to develop and communicate company objectives and initiatives. Once objectives are established at the functional level, these objectives form the foundation for team business updates. Management and team leadership commit to objectives that support companywide initiatives. As shown in the Performance Management Cycle (PMC, Figure 5.1-2), a three-step process links business plans and strategies to individual EO performance.

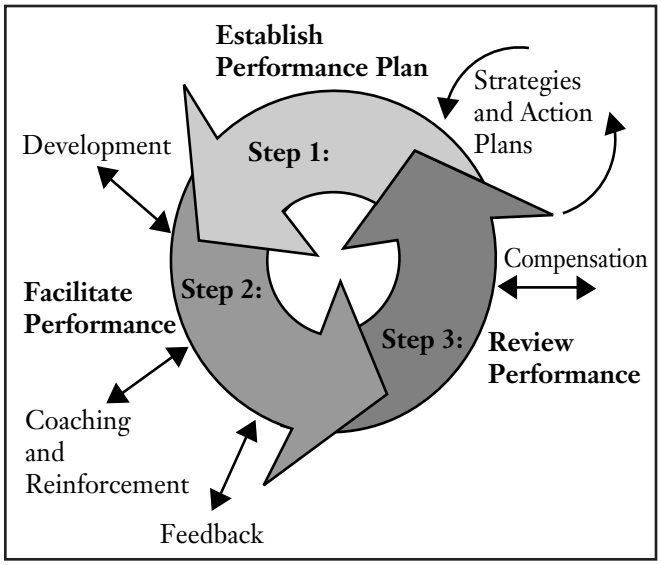

Figure 5.1-2 Performance Management Cycle

All EOs are enrolled in this process; each EO's performance is established and then evaluated for a 12-month cycle. The cycle starts (Step 1) two months before the beginning of the fiscal year, when the Leadership Team develops their performance plans; then the senior managers and team leaders establish their objectives within their reporting chain. Finally, by the beginning of each fiscal year, team members work with their leaders to develop performance plans. Resource requirements and plans are documented through the Marketing Requirements Document (MRD) and Plan of Record (POR) (Item 6.1).

At Collin, individual EOs have primary responsibility for their own development, but they are encouraged to work with their supervisors to create their individual development plans (Step 2). EOs and their supervisors identify development opportunities based on a number of inputs. First, they review the Competency Model for the EO's current position. (Separate Competency Models have been defined for the Leadership Team, directors, team leaders, team members, and individual contributors.) Since Collin's Competency Models define the characteristics and skill sets needed for effective performance in the position, this review defines basic developmental needs. Second, they review the performance plan developed in Step 1 to identify specific knowledge and skills the EO will need in order to achieve the plan and contribute to the achievement of Collin's overall objectives. Finally, they review the EO's career objectives to identify development opportunities that will support them. The EO works together with the supervisor to prioritize the opportunities identified and to determine appropriate developmental activities. In addition to formal education and training, these activities may include self-directed learning activities, work experiences, developmental assignments, and professional association memberships.

Assessments of individual development needs and the resulting development plans are completed during the annual Performance Management Process. When properly used, these development plans provide guidance to identify the skills and knowledge EOs need to not only accomplish their current performance objectives, but enhance their knowledge and career.

During the 12-month performance cycle, EOs receive coaching feedback on a quarterly basis concerning performance, leadership potential, development opportunities, successes, and opportunities for improvement.

This year, Collin expanded the development planning process for the Leadership Team and directors to include a 360-degree assessment of their individual performance against the appropriate Competency Model. Interviews, one-on-one meetings, and other 360-degree feedback tools are used to gather input and prepare a gap analysis. The results are fed back to the EO and serve as an additional input to the development planning process described above. The initial results indicate that this approach supports Collin's team-based culture and strengthens the development planning process. Deployment will continue to team leaders in 1999 and to all EOs in the following year.

At the end of the annual cycle, each EO's performance is assessed against their performance plan and integrated with results of customer surveys and Baldrige assessments, and the EO's compensation is adjusted according to established formulas (Step 3). The annual compensation of the Leadership Team is based upon the same formulas applied to all other EOs. These formulas have been agreed to by the entire work force.

Performance plans are fed back into the PPP via CAIN so that progress can be monitored and future plans for the company can be adjusted accordingly. This step is paramount to ensure that Collin is performing as a company for the benefit of its customers. In addition, this step has a direct relationship to the value of the Employee Stock Option Plan (ESOP).

Collin has an incentive award program based upon innovative suggestions submitted by EOs not in senior management positions. This system allows an EO to submit suggested process improvements or technology innovations. Each suggestion is reviewed in a team forum, and the suggester is compensated based on the proportion of the potential benefit that is assessed for the company.

Communication, alignment, and cooperation among teams are maintained by the pervasive use of CAIN and focus on the strategic and action plans resulting from the PPP. Two types of teams exemplify this approach. Sales coordinators, as well as EOs from Design Engineering, Quality Assurance, Manufacturing Engineering, and Finance, join customers and suppliers to identify long-term needs for futuristic products by serving on Integrated Product Development Teams (IPDTs). Due to the nature of their products (cutting edge) and the rapidity of market dynamics (product demand), these teams proceed through evolutionary stages in very short time frames. These stages are shown in Figure 5.1-3. The demand for training per team member is also reflected in this figure:

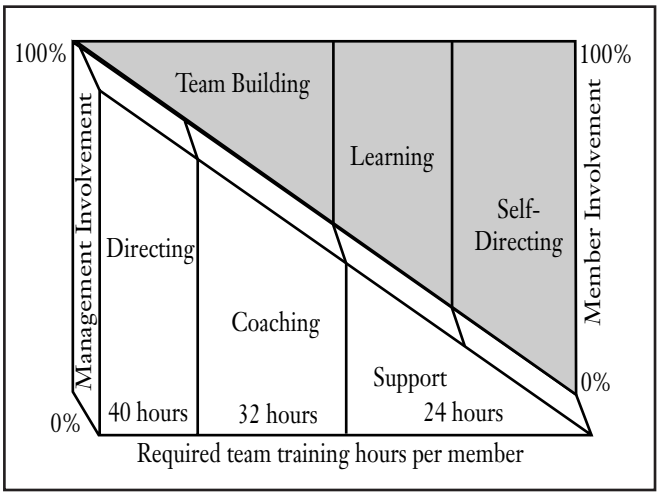

Figure 5.1-3 Stages of Team Development

The other team arrangement exemplifying this approach is the Process Support Team (PST), which consists of cross-functional team members from Product Development, Production Engineering, Operations, Marketing and Sales, EHS&S, Contracting, Finance, Customer Support (sales coordinators), and Human Resources. These are internally focused teams whose tasks are organized around specific objectives within a functional group to improve products in production. Each task has a specific start and completion date along with a unique definition for success. Collin EOs participate on these teams to ensure that work systems and programs are aligned and promote delivery of consistent solutions for all market segments. Growth in the number of teams and team training is shown in Figure 7.3-7.

To foster communications and promote information and skill sharing across functions and market segments, team members are co-located as much as possible, teleconferencing is widely used, and CAIN facilitates information transfer. Specific PSTs play a fundamental role in communicating changes in market conditions for existing products. All IPDTs must implement product features that will allow the sales organizations to successfully sell the product. Progress and issues from IPDTs and PSTs are discussed at weekly team review meetings. Issues of a strategic nature and difficulties in achieving defined objectives are communicated to the Leadership Team. Areas designated as high-risk are monitored closely. Deviations from the POR must be reviewed and approved by the entire team.

EO communications are achieved through quarterly all-hands meetings (held to review results and business objectives). In addition, Candice Trobaugh sends monthly (or more often) e-mails, and a website provides sources of information for field issues and customer satisfaction data.

In order to ensure that Collin continues to build a talented and diverse work force, it uses an Attribute Model that it applies to all potential hires. This model incorporates desired attributes such as personal and professional motivation, leadership potential, innovative skills, team orientation, diversity, technical knowledge, and understanding of customer-supplier concepts. This model is maintained in CAIN, where its results can be reviewed, and the model can be updated based on changing needs and situations. Collin aggressively seeks new people when openings occur. Sources of new hires are suppliers, customers, and competitors; graduate and undergraduate programs at both the University of Koga and Peak State University; community colleges in both the United States and Japan; Interskill; professional societies; and the student co-op programs.

The company's Compensation Committee is chaired by a member of the Leadership Team on an annual rotating basis. The Committee keeps abreast of trends in compensation programs throughout all complementary industries. When Paul McNulty chaired this committee in 1997, a benchmark suggestion system was identified during a discussion with a preferred supplier. Within three months, Collin investigated the comprehensive, streamlined system, modified it to suit the pace of its business, and implemented the modified system.

5.2 Employee Education, Training, and Development

Employee development is a key component of Collin's Invest-in-People strategy, which recognizes the critical influence, impact, and power of Collin EOs on the company's current and future success.

5.2a Collin's people development philosophy is competency-based, assessment-driven, and business-focused. It is designed to align employee development with the company's strategic goals so that employee development helps drive Collin from being skill-oriented to knowledge-oriented. Collin's people development program is individually tailored to build on the strengths of its EOs and enhance their competencies.

Vincent Daubert conducts the Human Resource Capabilities Assessment annually (Figure 2.1-2) to identify the capabilities necessary in Collin's advancing industry. These capabilities are a specific element of the strategic (long-range) and action (short-term) plans resulting from the PPP (Figure 2.1-1). These plans identify the subjects and skills necessary to educate and train EOs to satisfy upcoming technical and leadership requirements.

Future needs of both the organization and EOs are addressed in succession planning. Succession management activities are included in the Human Resource Capabilities Assessment. Using the Attribute Model and the assessment procedure described in Area 5.1a, core competencies for team and functional responsibilities are identified, and individuals are assessed against this Competency Model. Figure 5.2-1 shows the process that Collin uses to identify high potential EOs for leadership positions.

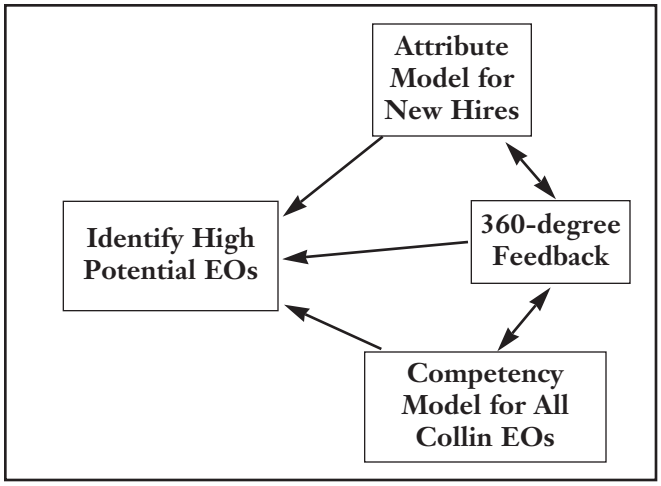

Figure 5.2-1 Leadership Identification

Historically, a primary driver of Collin's success has been the innovation and commitment of its EOs. Recognizing this fact, Collin implemented formal career paths for technical, managerial, operations, quality, and administrative positions — all of which are necessary to make Collin successful. The technical career paths provide a clear career road map for all technically oriented EOs as well as an advanced growth roadmap for key technical positions. The other career paths, which are designed to provide development for managerial, operations, quality, and administrative careers, follow a similar outline. The education and training program that integrates these road maps and the EO Development Process enhance Collin's ability to match employment needs with recruitment and retention efforts for a high quality work force. The career paths are subjected to an annual review by the HRC. This ensures that Collin develops the talent and skills which the company needs.

A number of sources are used as input for the PPP and provide Collin with valuable information about education and training needs (Figure 2.1-2). Baldrige self-assessments give all EOs the opportunity to share education and training needs, and inputs are supplemented with Baldrige inputs from preferred suppliers and customers. This internal input is complemented by external sources, including market surveys, customer surveys, government and industry sources, and third-party assessments. Human resource capabilities input is then compiled in CAIN, and collected and distributed for the resulting long- and short-range plans.

All Collin EOs attend a new-employee orientation class during their first week of work. Orientation helps new EOs become familiar with Collin's products, strategy, and Leadership Team, as well as employee benefits and opportunities. The orientation materials are also available on the company's website for reference.

Collin's training programs can be divided into five different areas:

- *Technical*, including information systems;
- *Managerial*, including leadership and organizational dynamics, innovation, ethical behavior, and team development;
- *Operations*, including manufacturing and customer contact management;
- *Quality management*, including Statistical Process Control (SPC), process improvement, and customer support relationship; and
- *Administrative*, including CAIN and EHS&S.

Collin offers an abundance of training classes in each of these areas, as well as event-based training driven by business needs. Collin strongly believes that people development is more than just training. People development includes on-the-job experience, self-directed learning, special projects, assignments to teams, and coaching from managers and other team members.

Collin relies on the local educational institutions to satisfy some of its educational needs. Peak State University and Koga University provide most of the technical and managerial courses needed by the EOs. At least three managers at each site teach classes at the universities in their technical specialties. In addition, community colleges provide educational benefits to Collin's EOs. Collin uses distance learning to offer this valuable training to both the Nashville and Koga work forces. Twice in the last year, Collin has sponsored a professor from Japan to teach short-term courses in Nashville and vice versa in Japan; this practice has yielded educational and cultural benefits.

Training is also provided by Interskill and vocational centers in the Nashville and Koga communities. Computer-based training has been a valuable and time-saving method to deliver training, especially in the manufacturing, information systems administration, and office administration specialties.

Informal training is provided by EOs who have special skills that are in high demand throughout the work force. This type of training is conducted in company training facilities at both plants and is often videotaped so that other EOs can view the sessions. Collin transfers technical specialists between plants to conduct short-term informal training.

Before any formal education and training approach is made available, it is piloted or tested with a representative sample of the target audience. In addition, course evaluation forms are completed at the end of training, and the results are tabulated and evaluated to determine effectiveness. Modifications are made to both the training content and approach, based upon the feedback. Finally, post-training assessments are also conducted three and six months after the training has been completed to determine the benefit the course has had on the job and its impact on actual job performance.

The utilization of quality standards, including metrics, performance standards, continuing improvement efforts, and quality controls, is a part of new employee orientation training. "Quality Leading the Way to Tomorrow" is the program that sets the stage for Collin EOs to embrace and utilize quality management in every aspect of their lives. Three levels of SPC are taught in local institutions; a basic level is taught at the Central Community College in downtown Nashville and in Hai Community College in Koga. Both undergraduate and graduate level college courses are taught in Koga University and Peak State University. To increase Collin's level of awareness and understanding of the techniques involved with benchmarking, the company invites speakers from best-in-class companies, as well as those known for conducting benchmarking studies, to address all EOs.

As part of creating their own development plans, EOs participate in self-assessment sessions. These sessions are designed to allow individuals to point out areas in which they may need additional knowledge. The use of assessments and the incorporation of "Quality Leading the Way to Tomorrow" into every business level and function provide a consistent path to success for Collin as a growing company.

5.3 Employee Well-Being and Satisfaction

In 1995, one of the key messages brought by Candice Trobaugh was that not only were EOs the company's most valuable resource, but that EOs, whether directors, managers, team leaders, individual contributors, or team members, are Collin. Therefore, the leadership system that has evolved is concerned that everyone in Collin live up to the expectations incorporated in the Core Values, one of which is to "become better at improving our EO's careers."

5.3a In today's marketplace, the integration of EHS&S practices into Collin's daily business is critical to its long-term success. No aspect of the business is more important than providing a safe, healthy, and secure work environment for employees while operating Collin's facilities in an environmentally sound manner. To this end, Collin has developed 50 minimum standards that govern work activities; 9 of these standards are listed in Figure 5.3-1. All directors and team leaders are responsible for ensuring that these standards are being met or exceeded within their areas of responsibility. These standards also serve as the basic audit criteria for the Collin EHS&S Audit Program. Collin measures performance to the standards in each group through monthly self-audits and biannual audits by the EHS&S Core Team.

Collin has implemented an aggressive EHS&S program consisting of mandatory safety and ergonomic training, voluntary self-audits against EHS&S minimum standards, development of Emergency Response Teams (ERT), and line management ownership of safety and security initiatives. Fred Fischer serves as the chair of the EHS&S Core Team. The team is responsible for monitoring and improving the ongoing EHS&S processes for the company. EHS&S objectives and target metrics are integrated into individual performance plans at all levels of the company. As a result of its EHS&S practices, Collin has consistently maintained one of the lowest rates in its entire industry for on-the-job injuries and continues to improve (Figure 7.5-4).

5.3b Since Candice Trobaugh arrived, company management no longer selects and evaluates EO support programs. All services and EO support programs are initiated through the HRC based on suggestions from EOs or Process Improvement Teams. Evaluation of

Type of Work Site	Minimum Environmental Standard
Administrative	Wrist rests will be attached to all keyboards.
Plating Site	Ventilation will accommodate 4 air changes per minute.
Loading Dock	Each EO will be provided a back support belt.
Design Module	Non-reflective screens will be installed on all computer terminals.
Training Room	Lighting will provide 100 lumens/ square foot of desk space.
Clean Rooms	All rooms will be pressurized at 1.2 atmospheres.
Team Meeting Room	Chairs with armrests and table space will be provided for 20 people.
Open Recycle Centers	Containers will be available to collect paper, glass, and aluminum.
Child Center	One certified child-care giver will be available for each 3-5 children.

Figure 5.3-1 Samples of Work Environment Standards

support services, benefits, and facilities using satisfaction survey data is part of the HRC and Leadership Team review cycles (Figure 7.3-5).

In order to build and enhance the work climate for employee well-being and satisfaction, Collin offers many services and facilities. For example, the Association of Collin EOs (ACE) sponsors special-interest clubs and a variety of other activities in which EOs at both work sites and their family members can participate. The company also sponsors one recreational center for each manufacturing site, where employees and their families can have picnics and enjoy activities such as canoeing, volleyball, and softball or visit the children's playground. Another recent addition is the child care center which offers discounted child care for EOs of both Collin and local preferred suppliers.

Collin is dedicated to promoting the health and wellness of its work force. Collin's substantial investment in health and wellness initiatives reflects its commitment to creating a more progressive and rewarding work environment that contributes to EO's physical and mental well-being. For example, Collin recently built a state-of-the-art Fitness Center at each location. It offers a variety of convenient services, most of which are free of charge. The Fitness Center is managed by fitness experts, who train employees on the proper use of fitness equipment and assist them in developing personalized fitness plans. The Fitness Centers also promote wellness through education, individual counseling, on-site screenings, and other convenient services. Collin also has an on-site medical clinic and full-time nurse at both facilities so that EOs can receive services such as immunizations, basic checkups, minor medical treatments, physical therapy, and massage therapy.

Additional services and opportunities provided and supported by Collin include: Employee Credit Union; Employee Assistance Program; Defensive Driving Classes; Tuition Reimbursement Program; On-Site Dry Cleaning and Film Processing Services; Child Care Referral; Adoption Assistance Services; Travel Services; and Participation in Community Activities.

5.3c EO satisfaction is measured through the use of regularly scheduled company meetings, one-on-one meetings, skip-level reviews, focus groups, exit interviews, and an employee satisfaction survey. Overall satisfaction can be demonstrated by Collin's ability to maintain EO turnover well below the industry average (Figure 7.3-8). Employees are also free to share any ideas, concerns, or suggestions through the Speak-Up Online Forum. Comments submitted are reviewed by the HRC and members of the Leadership Team. Issues are addressed, and appropriate actions are taken to resolve any problems (Figures 7.3-1, 7.3-2).

Since 1989, the Employee Satisfaction Survey has given the Leadership Team quality insight into the pulse of the work force. The survey is designed and coordinated by Interskill. Interskill utilizes focus groups throughout the organization to design the survey, and then it administers the survey on a quarterly basis. The survey uses a standard Likert differential rating scale ranging from Very Satisfied ("5") to Very Dissatisfied ("1"). Interskill presents results data to the Human Resource Council (HRC) and the Leadership Team at their next scheduled meetings. Interskill helps each group establish improvement priorities based on gap analysis (the difference between the importance and satisfaction ratings for each attribute ranked by their coefficient of correlation, the strength of the relationship between the attributes, and the overall rating). During these reviews, the HRC and the Leadership Team redefine attributes, request additional research using focus groups and/or critical-incident techniques, and identify potential solutions to address critical performance gaps.

The survey, along with exit interviews and EO focus groups, keeps Collin well informed about EO morale. Information from employee feedback and the Baldrige self-assessment is used in the PPP (Figure 2.1-1), the Product Development Process (PDP) (Figure 6.1-1), and the PMC (Figure 5.1-2). The PPP incorporates this information to ensure alignment. Collin's success is dependent on knowledge-based EOs. The environment they work in and the climate that surrounds them are significant factors in their high level of satisfaction and their low turnover rate (Figure 7.3-8).

6 Process Management

6.1 Product and Service Processes

Collin has documented all product and service processes throughout the organization. Both facilities have been verified to comply with ISO 9001. To meet the ISO 9001 certification, Collin took an integrated approach, meeting with its selected ISO registering agency and presenting a proposal that included all key elements required by ISO in Collin's internal assessment process. Because Collin regularly conducts internal assessments to the Baldrige Criteria (including ISO requirements) with published results, actions, and follow-up, it entered into an agreement with the ISO registrar that, with minor additions, these reviews would suffice and satisfy the requirements for ongoing ISO surveillance assessments. During most of these assessments, a participating member from the ISO registering agency is assigned.

6.1a The Product Development Process (PDP) is shown in Figure 6.1-1. This process is followed for all new circuit boards developed. Collin has created four boilerplate Product Requirements Documents (PRD) which address basic requirements by business segment. Specific customer requirements are then added during the PDP. The Plan of Record (POR) is created after prototype verification and in conjunction with the Marketing Requirements Document (MRD) that defines specific customer and manufacturing specifications. These are shown with an asterisk in Figure 6.1-1.

Figure 6.1-2 shows how the PDP is integrated into Collin's overall five-step product life cycle process that includes customers, suppliers, Integrated Product Development Teams (IPDTs), the Collin production process, and product certification.

Multilayer boards are designed to uniform rules that specify areas such as line widths and spacing with standard hole sizes and locations. These rules are adapted to individual customer requirements. Figure 6.1-2 also shows standard quality techniques such as Failure Mode and Effect Analysis and Quality Functional Deployment are utilized in design and product validation (Step 2), and verification processes (Step 3).

The design and production processes are maintained within the CAIN system, and changes to both are automatically included in the overall process.

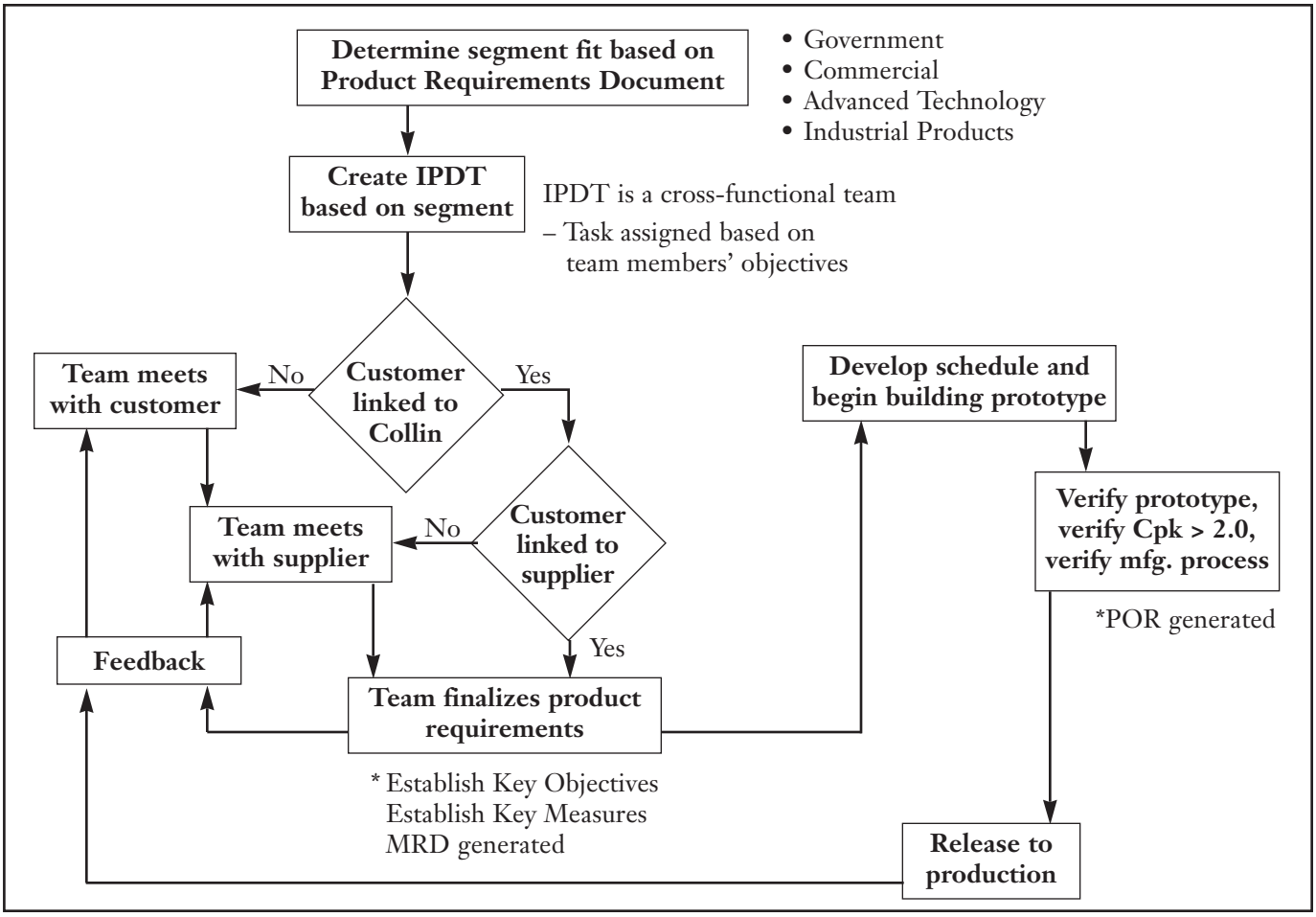

Figure 6.1-1 Product Development Process (PDP)

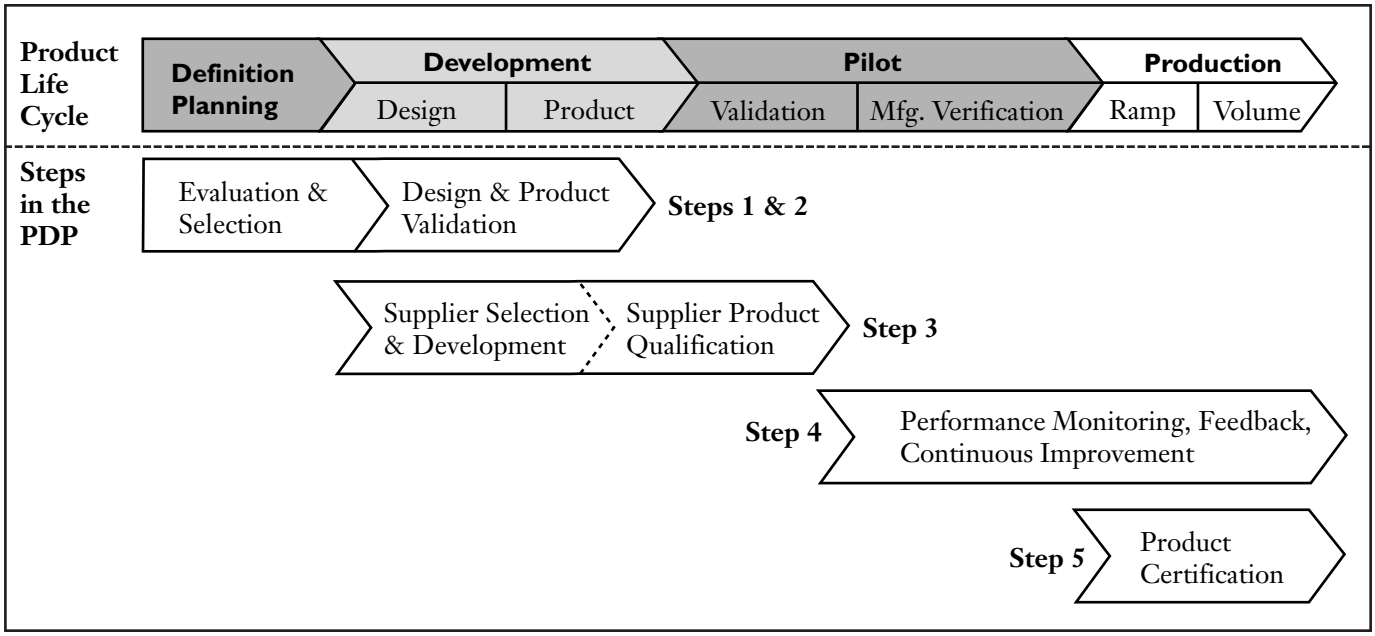

Figure 6.1-2 Integration of the Product Development Process and the Product Life Cycle

The automated production delivery system, controlled by CAIN, is designed to deliver prototypes overnight and production quantities within five calendar days for new orders or design changes. (The plants operate seven days per week.)

Key customers have a direct input to the CAIN system (Item 4.2) and are able to make changes to their products. Collin engineers enter changes for other customers. These changes may be the result of evolving requirements or conditions, or they may be the result of new technology that results in products of higher value.

Collin IPDTs and Process Support Teams (PSTs) also make changes to product design and processes. If modifications are required, the process laboratory ensures that the changes do not affect the capability of the process. These determinations are finalized in an eight-hour time period.

New technology is a constant driver, and the IPDTs and PSTs are continually involved in the loop of process and product design modifications. An example of how new technology is being applied in producing multilayer boards is the Chemically Bonded Deposition Process (CBDP). This proprietary process was developed for the Advanced Technology segment which requires applications for low current densities, and a very high number of lines are present. It uses a deposition process on bare substrates and does not utilize copper etching techniques. This new process results in fewer numbers of layers, smaller and lighter boards, and improved reliability. Production quantities are being produced in the process laboratory, and the volume is increasing. This process will be expanded to other customer segments as the need becomes applicable.

Board production is totally automated with tightly controlled processes to assure customer satisfaction. When a change in process is indicated, the IPDTs and PSTs review all characteristics, concentrating on any necessary changes from the established process.

These teams are responsible for maintaining and modifying all processes to reflect customer needs and the needs of maintaining the process capabilities for their range of responsibilities.

The design process is maintained and improved through the use of the design guidelines that are continually updated through knowledge and application of updated techniques and learning experiences. All information is contained within CAIN which distributes information to all locations. The best prevention tool to improve quality and reduce cycle time and costs is control through robust process capability studies and ongoing process control. The IPDTs work closely with customers and suppliers and maintain the production processes. All processes are designed to operate within a minimum Cpk of 2. Changes in any parameter must meet the minimum Cpk requirement. This has resulted in quality defects measured in parts-per-billion. PSTs follow the same criteria but remain more internally focused. The results of aggressive process design and control are shown in Figure 7.5-12. This figure includes both production processes and support processes.

The process laboratory is used by both the IPDTs and PSTs to facilitate the design validation and product verification processes. It is also used to improve product Cpk levels and meet Collin's target goal of Cpk of 2 prior to production release.

Since all inner and outer layers of boards are automatically bar coded when released into the production process, all units have unique identifying numbers that are continually tracked throughout the process with historical records established in CAIN. The bar coding on the boards automatically alerts the production process for any changes as an individual order proceeds through production.

6.1b The key production/delivery processes and their key performance characteristics are listed in Figure 6.1-3. All deliveries are made with a carrier that tracks location and by air to minimize the time in transit.

Production Process	Key Performance Characteristics
Material preparation	Dimensions, cleanliness, no surface imperfections
Exposing and development	Dimensions of lines and spacing, no shorts or opens
Laminating	Dimensions, cleanliness, no delamination of layers
Drilling	Hole size and locations, cleanliness of holes
Plating	Thickness and adhesion of plating
Delivery	Minimized time in transit

Figure 6.1-3 Production/Delivery Process

Production processes are precisely controlled by CAIN with a process capability designed to operate with a minimum Cpk of 2. Some individual processes are designed and controlled with Cpk's as high as 10. The processes are sampled with an in-process sampling plan that ensures that they remain "in control" and the mean values are maintained. The results of these samples are tracked for preventive purposes. An example of an in-process sampling audit is shown in Figure 7.5-9.

Test coupon holes are automatically designed in all boards to provide test-plated holes for process verification and assurance that the production process performs as designed.

By utilizing a process design that is well within the design tolerances and maintained by an adequate sampling plan, Collin ensures that products meet customer requirements. Figure 6.1-4 shows some of the characteristics sampled to ensure process control.

Characteristics	Frequency	Product or Process
Copper surface	1%	Product
Layer thickness	1%	Product
Plating characteristics	4x/shift	Process
Hole cross-section	1/panel	Process
Environmental testing	1/production lot	Process/product

Figure 6.1-4 Process Verification

Collin products are designed to operate in extreme environments. To ensure performance on a sample basis, boards are subjected to extreme environmental conditions to verify compliance with customer requirements and to ensure reliable lifetime operation. These tests are performed in the process laboratory.

The PSTs are responsible for all production processes and are constantly looking for ways to improve processes as new technology becomes available. Improvements in production and design capability also help to reduce cycle time and cost and enhance quality.

A prime customer need, cycle time reduction is constantly monitored when improvements are implemented. Cycle time results are shown in Figure 7.5-1. IPDTs and PSTs benchmark other companies' processes in the multilayer printed circuit board business and utilize the University of Koga and the Peak State University which perform extensive research work in new board processes. Through the Continuous Improvement Process (Figure 6.1-5), Collin maintains control of key processes while identifying opportunities for improvement. When opportunities are

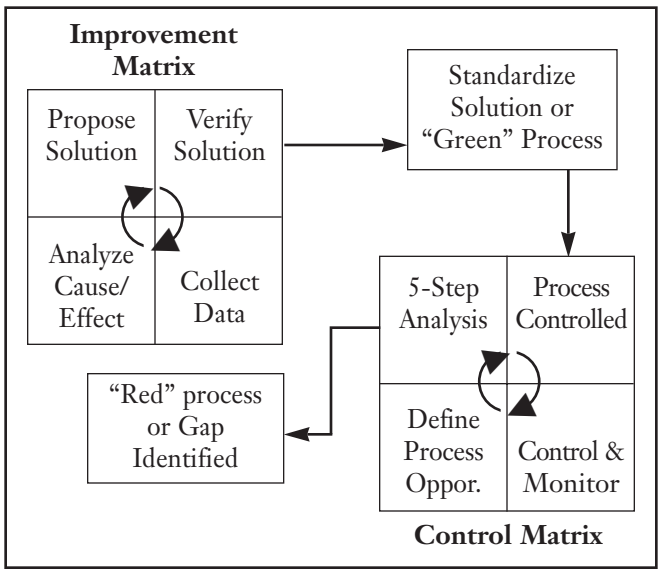

Figure 6.1-5 Continuous Improvement Process

identified, the "5-Step" analysis process is used to verify that improvements are warranted. Improvements are made using the improvement matrix shown in Figure 6.1-5. To ensure that processes are maintained in a preventive manner, the data are continuously analyzed using the "5-Step" approach described in Figure 4.2-1. Customers and suppliers also provide valuable information to aid in process improvements. Many changes have been made in response to their suggestions.

The facilities in Nashville and Koga are nearly identical. When equipment is purchased for one facility, a duplicate is purchased for the second. In addition, CAIN facilitates sharing and updating of information on an ongoing basis. This constant updating ensures the consistency of products and processes, learning, and production flexibility.

6.2 Support Processes

6.2a Recognizing their importance, Collin treats support organizations in the same way as product and service organizations relating to process design, monitoring, and control. Each support process is designed by a PST assigned to the responsible organization. The assigned PST uses the same criteria as production and design processes for a Cpk of at least 2.0.

As a result of the company's strategic initiatives, some support organizations are considered key support processes. Key support processes, organizational areas of management responsibility, and measurements are listed in Figure 6.2-1. Associated results are shown in Category 7. Key support processes are distributed across the total organization. During the Perennial Planning Process, inputs that concern support processes are examined. The inputs from internal and external customers, other EOs, and preferred suppliers contribute to this determination. The PST utilizes CAIN and analyzes inputs from customers, EOs, and suppliers to establish measures and stretch goals for the various key characteristics.

PSTs have the responsibility for continual improvement of the support processes utilizing the Continuous Improvement Process shown in Figure 6.1-5. In weekly meetings, PSTs review input information and results to make improvements in the various support processes. All process flow charts are contained within CAIN and are available to customers and suppliers as well as EOs. Multiple inputs are utilized from customers, EOs, suppliers, benchmark processes, and local universities.

Results charts are part of the ongoing business reviews and are posted in the BSC and output measures for all EOs to utilize.

As a result of the nearly identical processes between the two locations in Nashville and Koga, driven by the CAIN, all information is transferred and changes incorporated immediately.

6.3 Supplier and Partnering Processes

Figure 6.1-2 illustrates how Collin involves suppliers in the PDP to ensure availability of materials and services that satisfy quality, cost, and performance utilizing advanced technologies.

Leadership	Process	Requirement	Measurement	Results
Daubert	Safety	EOs	Accident incidents	7.5-4
Fisher	Environment	Air emissions	Emissions to atmosphere	7.5-13
	Waste handling	Waste water	Contaminants	7.5-14
		Waste to landfill	Reclaimed material	7.5-15
			Solid waste disposal	7.5-16
Yacobi	CAIN	Information system	Availability & response time	7.5-3
Michelli	Maintenance	Equipment operation	Automation system up-time	7.5-5
	Material	Support operations	Quality/cost/responsiveness	7.4-3, 7.4-4, 7.4-2
Trobaugh	Asset management	Reinvestment opportunities	Asset investment rate	7.2-5, 7.2-7, 7.2-8
McNulty	Finance	Improving results	Return on revenues	7.2-6
Waterman	Outsource operations	System software	Responsiveness/cost	7.4-1, 7.4-2

Figure 6.2-1 Key Support Processes

Collin's preferred suppliers have access to the CAIN system with full visibility of future requirements. Preferred suppliers are directly involved in the Collin Perennial Planning Process.

6.3a Suppliers are classified into two categories. The first are considered manufacturing suppliers who furnish raw materials such as copper clad sheets and inner layer bonding material. Drill bits, necessary chemicals for the exposing and etching processes, and plating chemicals and materials, including copper, lead, and gold, are also required. The second category includes service providers providing the CAIN information system with computer software and hardware; education, training, and service support for EOs; and the uninterruptible back-up power systems. Both categories of suppliers are handled with the same processes utilizing assigned process teams.

Collin works with individual suppliers to determine specific performance requirements and measures for each of the following five dimensions:

1. Quality;

2. Cost;

3. Availability and Delivery;

4. Technology; and

5. Continuous Improvement.

Of these, quality, cost, and on-time delivery have a direct impact on Collin's ability to meet its customers' demands for high reliability and fast delivery at lower prices and are measured for each purchase (Figures 7.4-1 through 7.4-6). The last two dimensions are assessed on a quarterly basis by the relevant PSTs.

Collin's goal is for all suppliers to achieve preferred supplier status (Figure 7.4-7). To qualify, the supplier must rate above 95% overall and above 90% on each performance dimension. Supplier results are shown in Figures 7.4-8 and 7.4-9.

All preferred suppliers receive full access to CAIN, which displays all performance characteristics throughout the total organization. The suppliers can see how their own materials are performing on an ongoing basis and are expected to develop and implement any necessary corrective actions immediately. Because preferred suppliers are considered full members of the Collin team, they also participate in IPDTs and are invited to all training programs available to Collin EOs.

Although not-yet-preferred suppliers' access to CAIN is more limited, they receive ratings on their performance in any quarter in which Collin purchases their materials or services. When a problem arises, Collin notifies them electronically, and they are expected to initiate corrective action immediately. If quarterly ratings indicate that a supplier would benefit from attending a Collin training program, they are invited to attend.

Since Collin remains on the cutting edge of technology, suppliers are eager to tap into the knowledge and experiences that will be necessary in future business dealings with any company in the printed circuit board business. Suppliers, therefore, are anxious to participate in the various learning experiences that Collin provides (Figure 7.4-10). They are also willing to share comparative and benchmark data with Collin in order to help it remain on the cutting-edge.

All suppliers are expected to continually improve. That factor is one of the five area ratings that are performed quarterly. The same improvement process shown in Figure 6.1-5 is utilized by suppliers. The improvement matrix is examined to continuously improve the supplier process at least once every quarter. This continuous improvement process ensures that Collin's suppliers will accomplish the stretch goals determined in the ongoing Perennial Planning Process.

Both facilities in Nashville and Koga utilize the same production processes, supplier selection and management process, and process for improvement. The CAIN system provides information in real time to both locations and to suppliers.

7 Business Results

7.1 Customer Focused Results

Customer Satisfaction (Direct Measures)

[Note: Unless otherwise specified, all '99 data reflect goals for 1999.]

Figure 7.1-1 shows current performance levels and five-year performance trends for overall customer satisfaction in each of Collin's four key business segments. (See Area 3.2b for a description of the rating scale.)

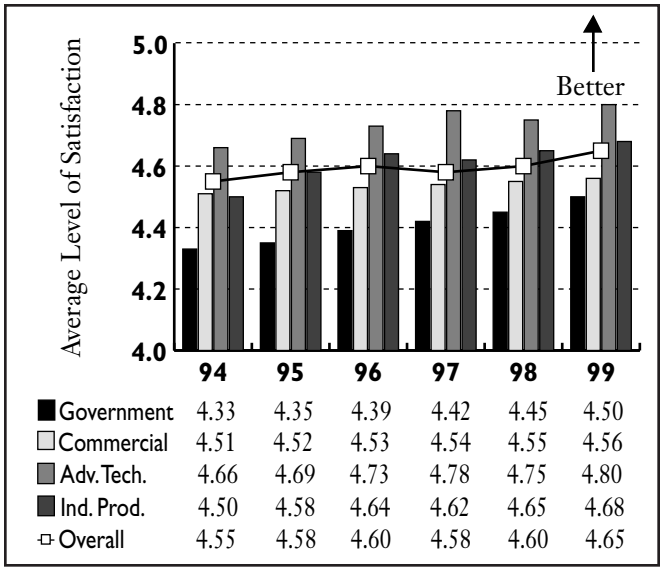

Figure 7.1-1 Overall Customer Satisfaction Ratings by Business Segment

Customer Dissatisfaction

Figure 7.1-2 shows the overall percentage of Dissatisfied and Very Dissatisfied ratings received on any satisfaction attribute on all surveys for each of Collin's four key business segments. Collin has received nine overall "Dissatisfied" ratings and no overall "Very Dissatisfied" ratings on these surveys in the last five years.

Collin tracks additional measures of dissatisfaction. The company has not experienced any product or service recalls or litigation, nor has Collin received any state or federal sanctions in its history. Warranty costs for the last five years averaged less than $1 for every $5,000 sold.

Figure 7.1-3 shows the percentage of complaints, both overall and by segment, for the last five years. These data normalize the percentage of complaints for every 10,000 boards shipped to that segment that year to show relative performance year to year and segment to segment.

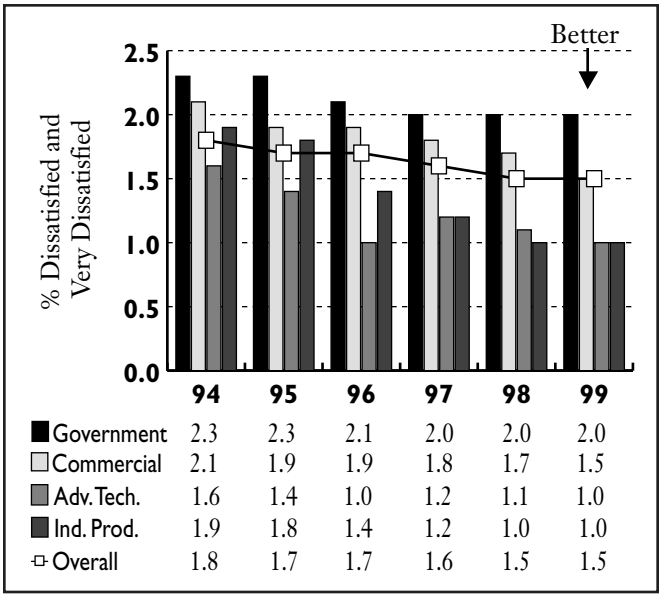

Figure 7.1-2 Percent Product Dissatisfaction Ratings by Business Segment

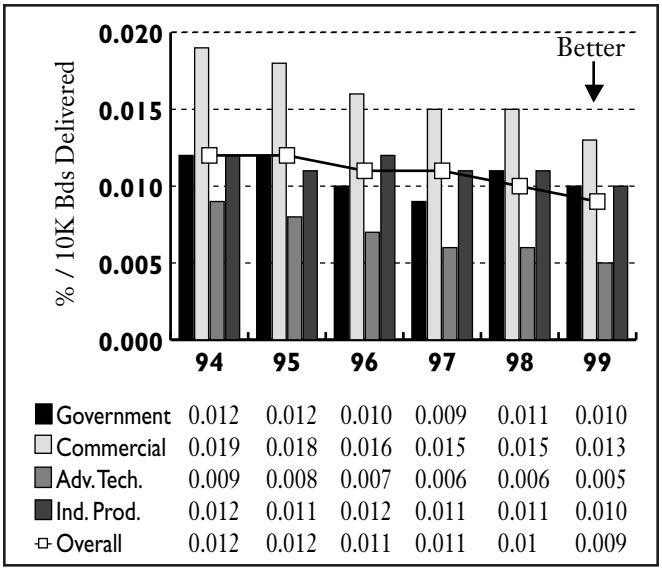

Figure 7.1-3 Normalized Customer Complaints by Business Segment

Customer Satisfaction (Indirect Measures)

Figure 7.1-4 lists Collin's five-year performance for indirect indicators of customer satisfaction. Collin selected these indicators because they are deployed throughout the business relationship cycle and because they have proven to be reliable leading indicators of customer satisfaction. They are shown in the approximate order they occur in the typical business relationship. As you can see, Collin's performance improves as the relationship develops.

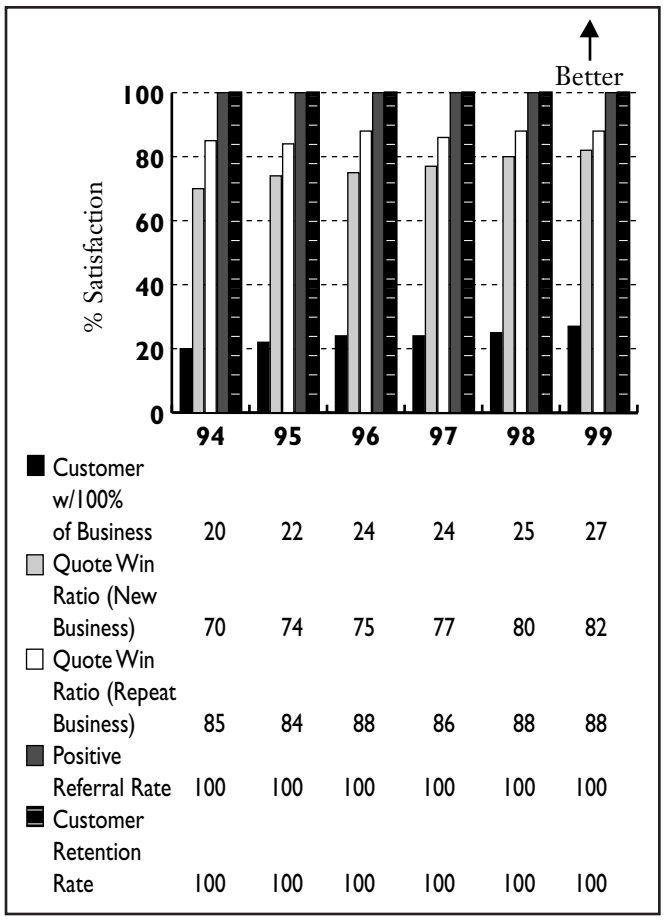

Figure 7.1-4 Indirect Customer Satisfaction Indicators

Product and Service Performance

Figure 7.1-5 presents Collin's current performance levels and five-year trends for customer satisfaction with board quality for the company overall and for each of Collin's four key business segments. Overall board quality is now at 100% for all segments. Implementation of internal quality programs, such as stabilizing and controlling processes and modern production techniques, increased quality to 100% as measured by Collin's customers.

Figure 7.1-6 shows the percentage of boards accepted by customers. Since customers test their products prior to placing them in service, this measures the number of Collin non-conformances detected by customers. A comparison of customer satisfaction with product quality measured by survey processes (Figure 7.1-5) with the percentage of boards accepted by customers (Figure 7.1-6) demonstrates the contribution of Collin's warranty policy, follow-up, and relationship building processes (Area 3.2a). Although customers continue to reject a small number of boards due to damage in transit, late delivery, etc. (Figure 7.2-11), Collin achieved 100% customer satisfaction with overall product quality in all segments last year.

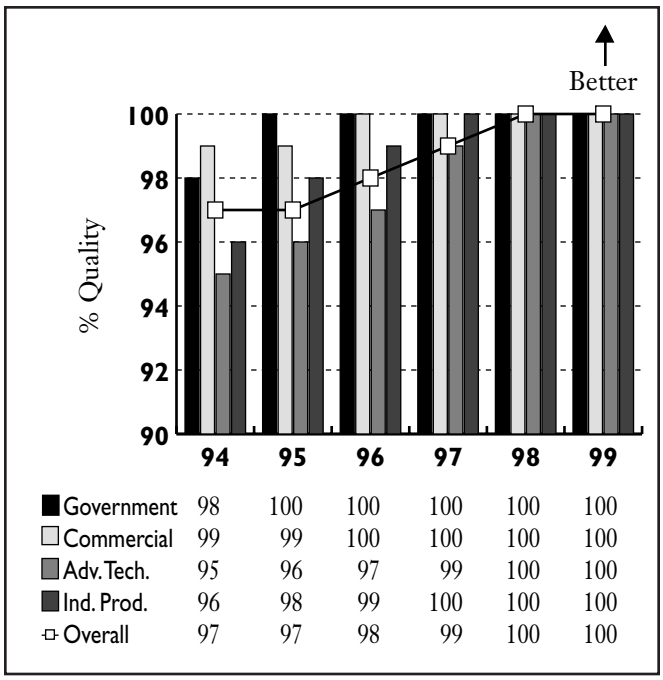

Figure 7.1-5 Customer Satisfaction With Product Quality by Segment

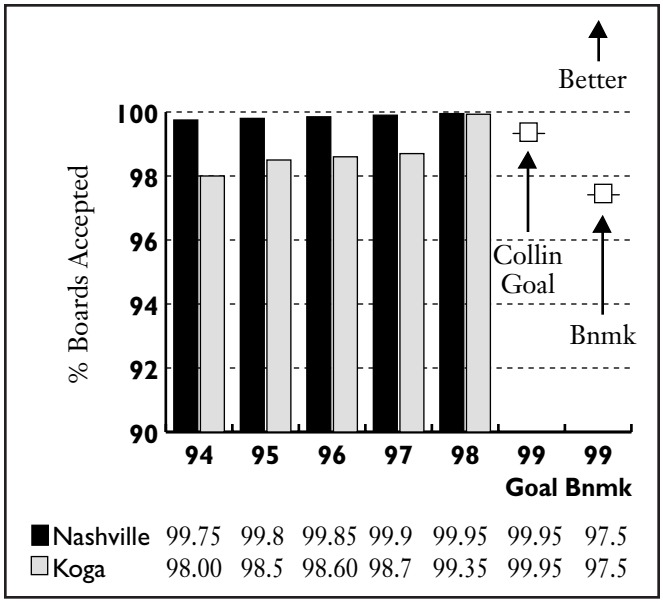

Figure 7.1-6 Boards Accepted by Customers

In 1994, Collin's on-time delivery performance was about the same as that of its best competitor. By improving cycle time and supplier on-time delivery, Collin has consistently improved performance and now leads the competition on this key customer requirement (Figure 7.1-7).

Figure 7.1-8 shows product reliability throughout the product life cycle. This quality indicator not only

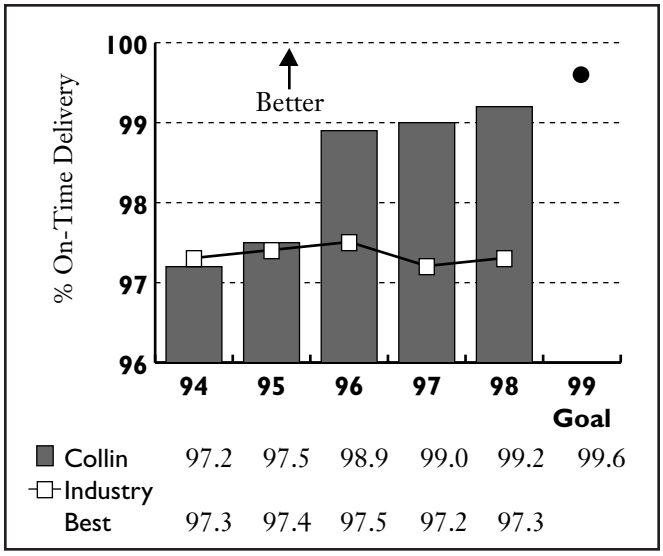

Figure 7.1-7 On-Time Delivery

contributes to consistently high satisfaction ratings (Figure 7.1-1) but also drives customer loyalty indicators, such as Repeat Business, Positive Referral, and Customer Retention (Figure 7.1-4).

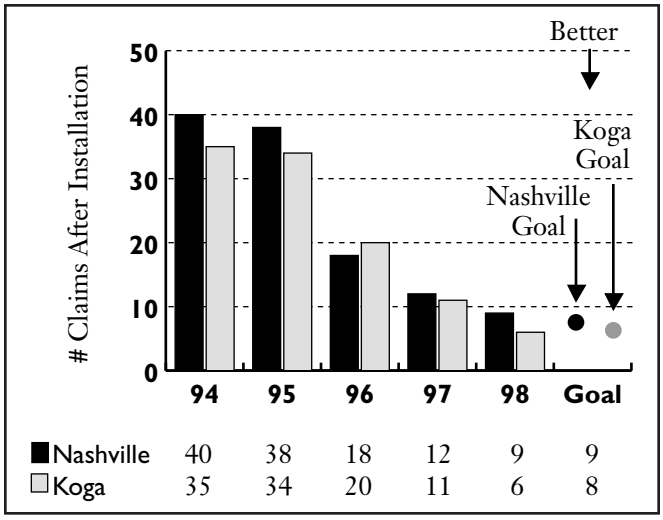

Figure 7.1-8 Product Reliability (Customer Use)

Figure 7.1-9 shows that Collin's overall Field Quality Index has improved steadily over the previous five years. The customer returns, replacements, and repairs are combined into this single Field Quality Index to give an overall quality score. All three of the indices are individually tracked. The total field quality score also includes Collin's informal warranty policy of replacing defective boards that customers believe are Collin's responsibility. These multiple product performance data are gathered throughout the customer relationship cycle. They confirm the importance of Collin's warranty policy (Figure 7.2-11), follow-up, and relationship-building processes (Area 3.2a) for recovering from missteps, achieving total customer satisfaction (Figure 7.1-5), and improving the company's overall position in the eyes of customer stakeholders. This is one of Collin's basic Core Values (Figure 1.1-1).

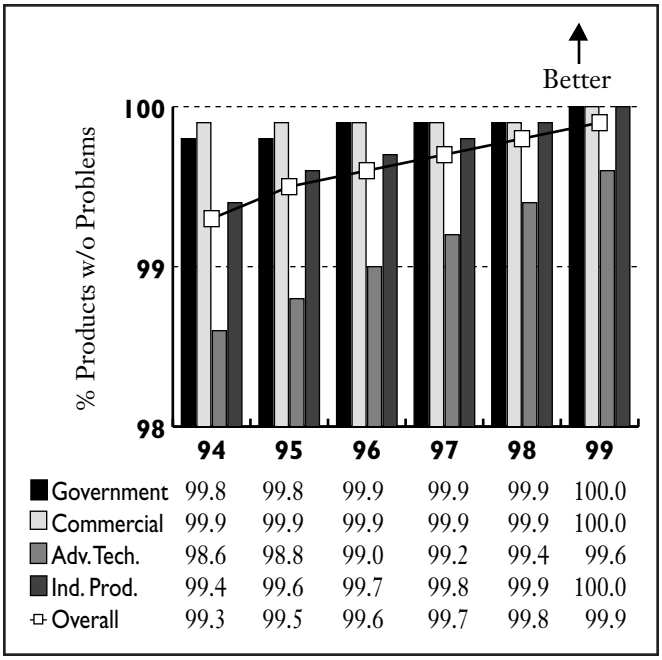

Figure 7.1-9 Field Quality Index by Segment

Figure 7.1-10 compares Collin's (CT) performance to the best performance among any of its four major competitors (BC) on the internal indicators Collin uses to predict customer satisfaction. The major competitors are KTFL, Ace Circuits, Ridgeford Technology, and Worldwide Corporation. Collin exceeds the "best of breed" performance among competitors in all measurement areas rated most important by its customers.

Indicator	96 CT	96 BC	97 CT	97 BC	98 CT	98 BC
Overall Satisfaction Rating	4.60	4.25	4.58	4.22	4.60	4.23
Product Quality Rating (%)	98	85	99	85	100	85
On-Time Delivery (%)	98.9	97.5	99.0	97.2	99.2	97.3
Field Quality Index (%)	99.7	92	99.9	93	100	91
Complaints (PPM)	1.1	11.2	1.1	12.0	1.0	11.1

Figure 7.1-10 Best Competitor Comparisons

7.2 Financial and Market Results

Financial and market performance results are often viewed as the ultimate measures of a company's success. Likewise, Collin views these results as being crucial to satisfy the needs of all of its stakeholders and to balance all results. Because of these results, the company has earned a reputation for being an industry leader in the advanced, high performance and reliability multilayer printed circuit board industry. Figure 7.2-1 records this growth in revenue relative to 1991 revenues.

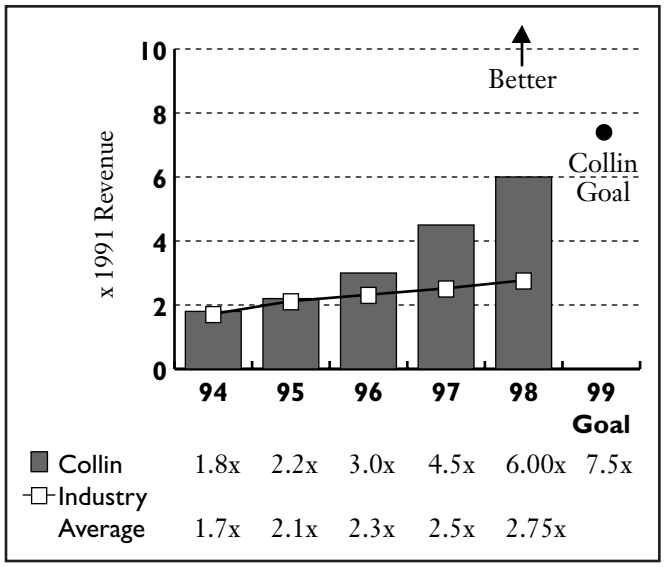

Figure 7.2-1 Company Revenue Growth Trend

Over the past eight years, there has been astounding growth in Collin's revenue. This is due in part to Collin's increase in reliance on automation and its success at integrating human capabilities with the speed of automation, making it possible for Collin to satisfy an increasing number of customers and their changing needs. Figure 7.2-2 shows the growth in revenue among Collin's key customer segments.

To demonstrate the trends in these growth patterns across Collin's primary global markets, Figure 7.2-3 shows this growth in Collin's key markets since 1994. The growth in the European market is presently satisfied from Collin's Tennessee production facility. In addition to these markets, sales in the South American market have just started to escalate; although this new market has substantial potential, the company considers it premature to include it in this application.

Profits represent the amount of compensation Collin can provide to its stakeholders for their support and participation in ensuring company success and to its EOs and executives for a job well done, and the amount of return to the company to accommodate modernization and technological advances. Collin has been

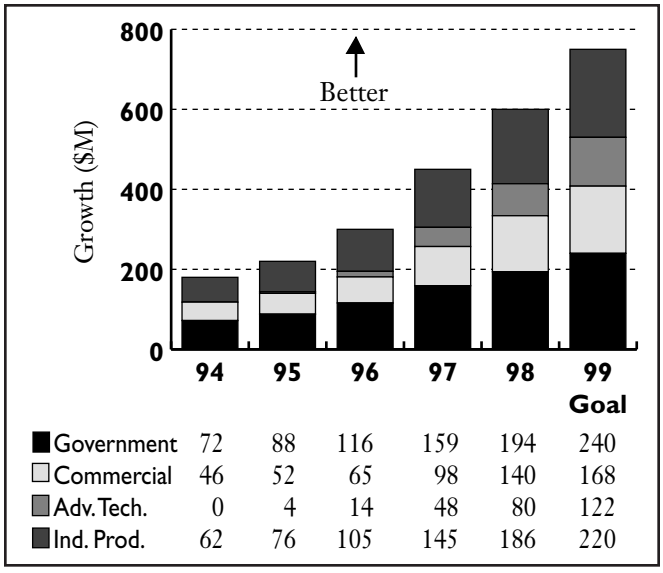

Figure 7.2-2 Revenue by Customer Segment

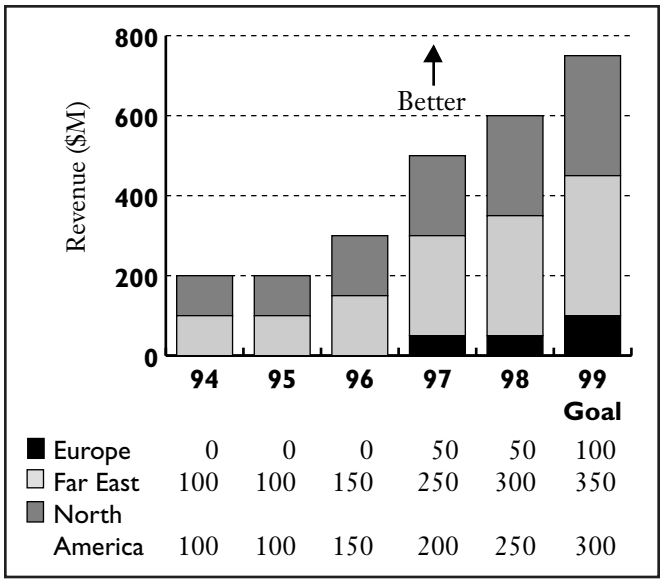

Figure 7.2-3 Revenue by Global Market

fortunate to be able to convert the increase in revenues into more of an increase in profits. Collin's six-fold revenue increase has resulted in a dramatic 30% increase in profits annually since 1991. Collin generated over $90 million profit in 1998. This growth trend is shown in Figure 7.2-4.

Prior to 1995, Collin tracked Return on Investment (ROI) for the purpose of monitoring how it leveraged investments. The performance based on ROI was very good; however, with the change in leadership in 1995, the focus on ROI decreased, and the interest in asset management became primary. The metric Return on Net Assets (RONA), which provides a good indicator of shareholder value, became a key metric for financial performance (Figure 7.2-5). RONA is the product of

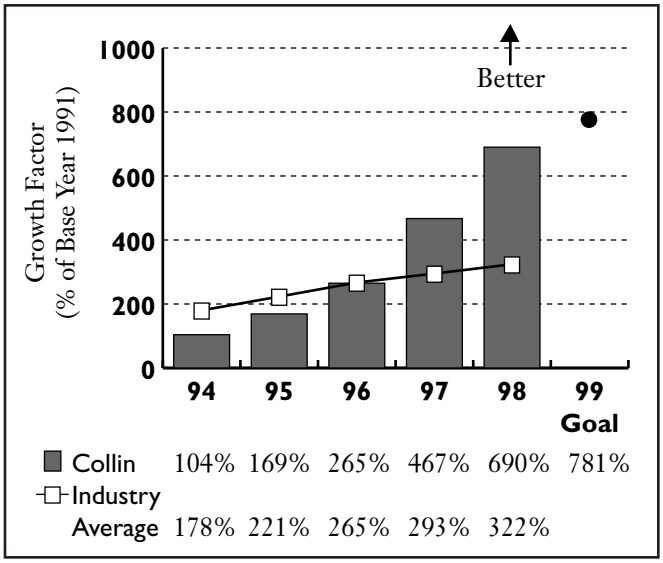

Figure 7.2-4 Company Profit Growth

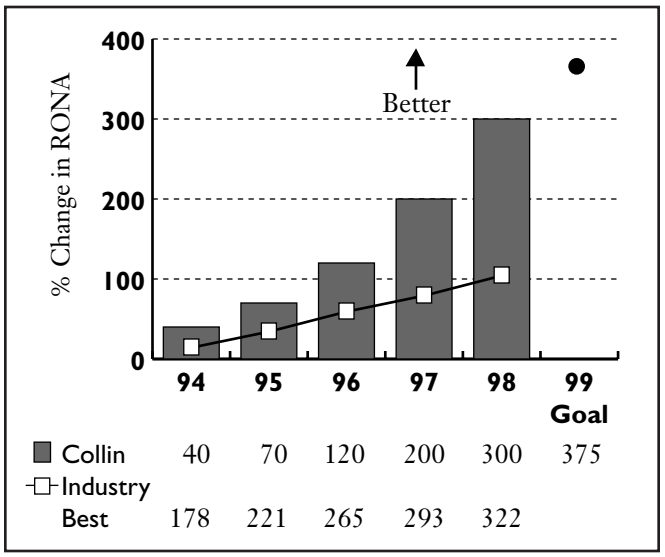

Figure 7.2-5 Growth of Return on Net Assets (RONA)

Return on Revenues and Net Asset Turnover, and thereby incorporates the costs of upgrades and modernizations which are increasingly important in a capital and technology intensive industry like Collin's. RONA is not yet a widely used metric in this industry, so Collin continues to search for an industry-related organization which uses appropriate benchmarks for comparing RONA.

This strong performance in RONA was supported by significant increases in both Return on Revenues (ROR) and Net Asset Turnover. The improvement in ROR was prompted from increased emphasis on management of costs as reflected in goals established for key processes over the past few years (Figure 7.2-6).

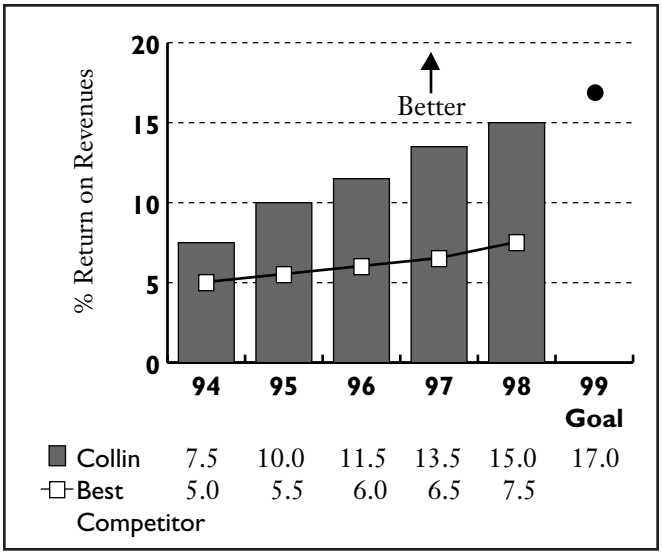

Figure 7.2-6 Return on Revenues (ROR)

Net Asset Turnover (Figure 7.2-7) measures both productivity increases which are occurring as well as Collin's ability to manage its facilities. Collin's low debt-to-equity ratio (0.55) allows the company to leverage its debt-to-finance increases in manufacturing capabilities and to expand into foreign markets, particularly the Far East and Europe. Collin's performance in Net Asset Turnover is shown in Figure 7.2-7.

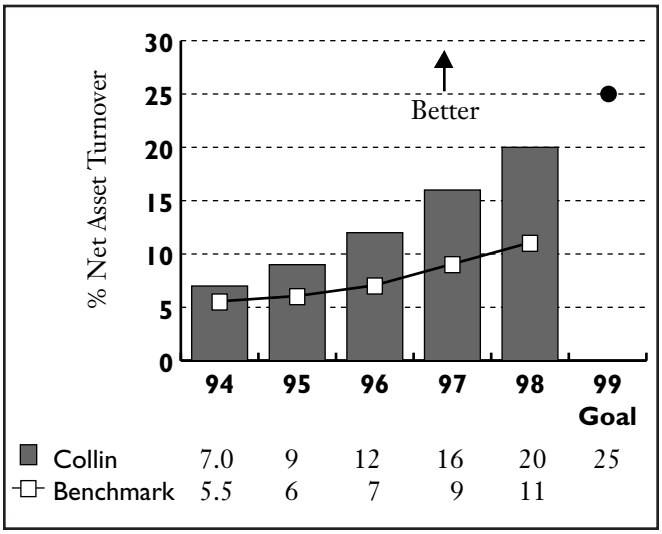

Figure 7.2-7 Net Asset Turnover

To ensure that the company's growth rates are sustainable, Collin reinvests a substantial portion of its profits into updating and modernizing its assets, based on revenue achieved each year (Figure 7.2-8). The increases in 1996 and 1998 represent substantial plant upgrading initiatives; plant replacements are scheduled for Year 2000. In addition, some of Collin's preferred suppliers,

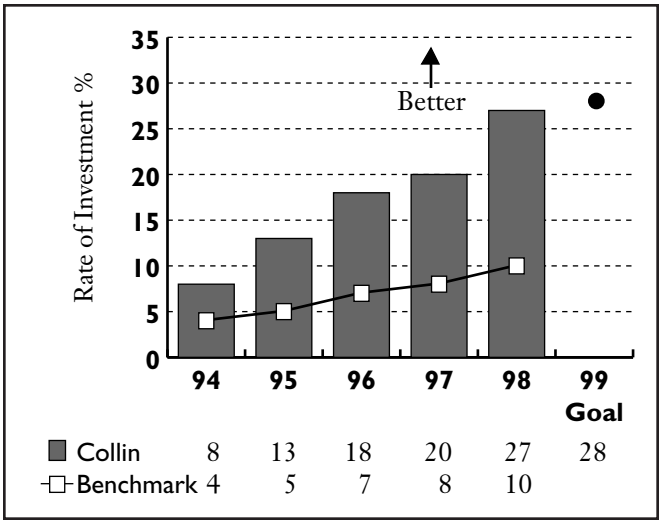

Figure 7.2-8 Asset Reinvestment Rate

who can also improve from some of these advances, provide additional funds through partnership agreements for asset enhancements.

Inventory Turns (Figure 7.2-9) provide a measure of how fast a company's inventory moves through the business. In other words, it represents how long a company's capital must be dedicated to supporting its inventory. Because of the preferred supplier program and Just-In-Time (JIT) inventory practice at Collin, this measure has very large values that reflect Collin's efforts to minimize its inventory investments.

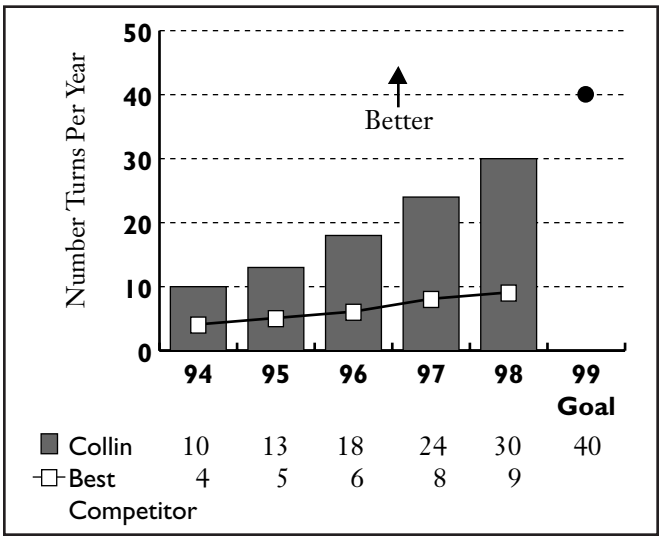

Figure 7.2-9 Inventory Turns

In 1996, Collin shifted its emphasis from measuring "cost of goods sold" to measuring "value-added" for its customers. The latter measure is calculated by dividing the sale price of a product by production costs. (Costs associated with support processes are not yet included in the measure.) Production costs include the cost of components purchased from suppliers, the cost of the facilities used to manufacture the product, and labor costs (i.e., salaries, benefits, and other related costs.) Results presented in Figure 7.2-10 indicate that Collin's value-adds are more than three times its costs for a conventional (not CBDP), multilayer printed circuit board for the Advanced Technology segment and more than double for a typical board for Commercial applications. Collin is still broadening its understanding of the value-added concept and plans further refinements in this measure (e.g., incorporating costs for support processes). To date, Collin is not aware of other companies in the industry which use a similar metric; therefore, no comparisons are provided.

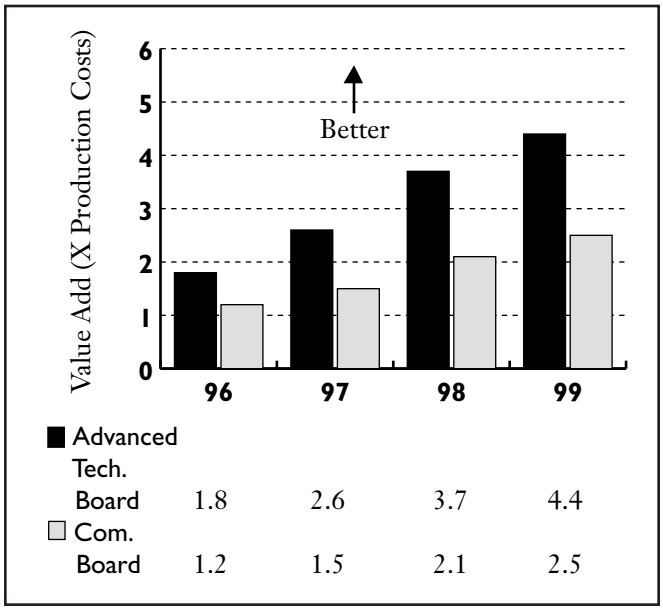

Figure 7.2-10 Value Adds

The reliability of Collin's products represents a key input to the financial performance of the company. One of the best measures of product reliability is the amount of warranty activity the company experiences with a growing number of its products in the field. Collin has a customer-focused warranty, the only one like it in the industry; yet in 1998, with $600 million in sales, only 15 warranty claims were made (Figure 7.2-11).

In addition to being solvent (low debt-to-equity ratio), Collin's debt utilization is demonstrated by the large number of times that interest is earned to cover its external financial sources (see Figure 7.2-12).

The multilayer printed circuit board market alone was a $6 billion business in 1998. Collin's increasing market share has progressively made a reputation for itself in the advanced, high performance, high reliability niche of this market. Collin has established itself as a growing and respected supplier. Accompanying increased sales

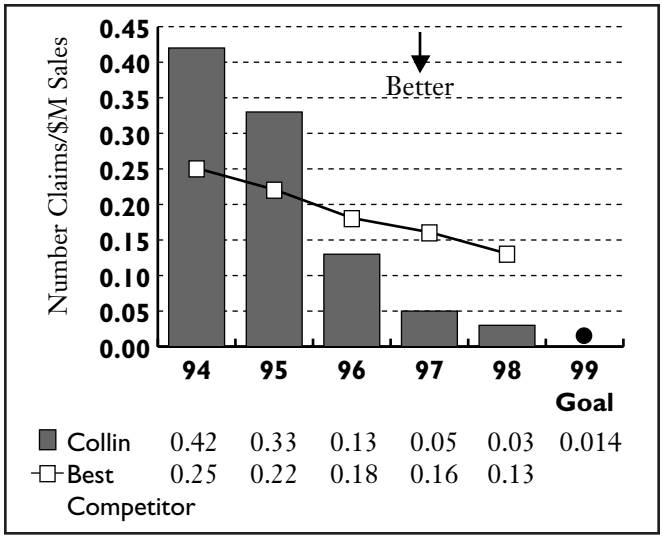

Figure 7.2-11 Warranty Activity

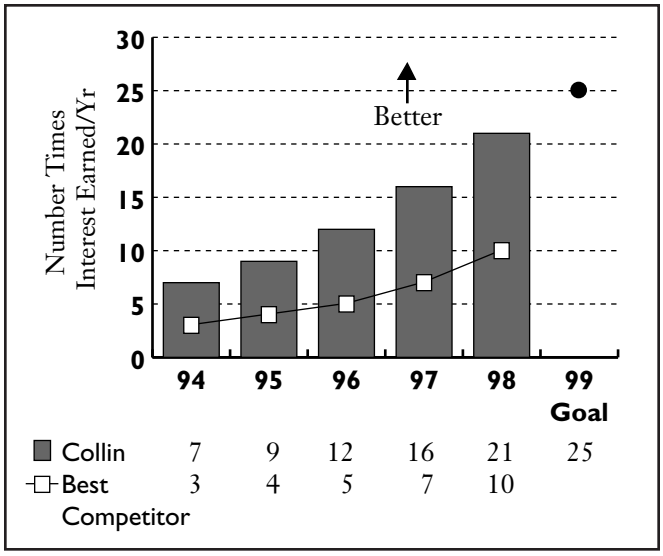

Figure 7.2-12 Times Interest Earned

worldwide, larger volumes are being encountered in the Government and Industrial Products segments (Figure 7.2-2).

Among Collin's strengths are the rapid development and targeted marketing of its unique new products. As shown in Figure 7.2-13, these capabilities result in substantial sales from new products in all customer segments and contribute to Collin's position as a market leader.

Collin has always led the competition in overall market share, but the strategic changes made by the Leadership Team in 1995 have enabled Collin to widen the gap relative to its best competitor (Figure 7.2-14). This market share growth has occurred across its key segments, as illustrated by the breakdown of market share by segment and geographic region in Figure 7.2-15.

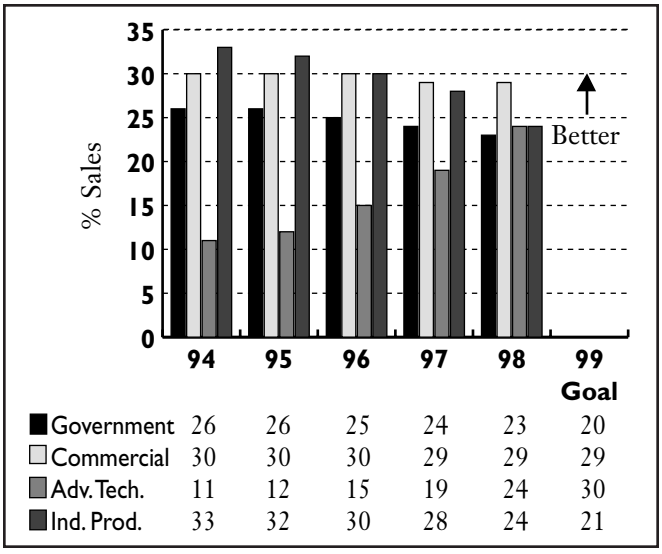

Figure 7.2-13 Percent Sales from New Products

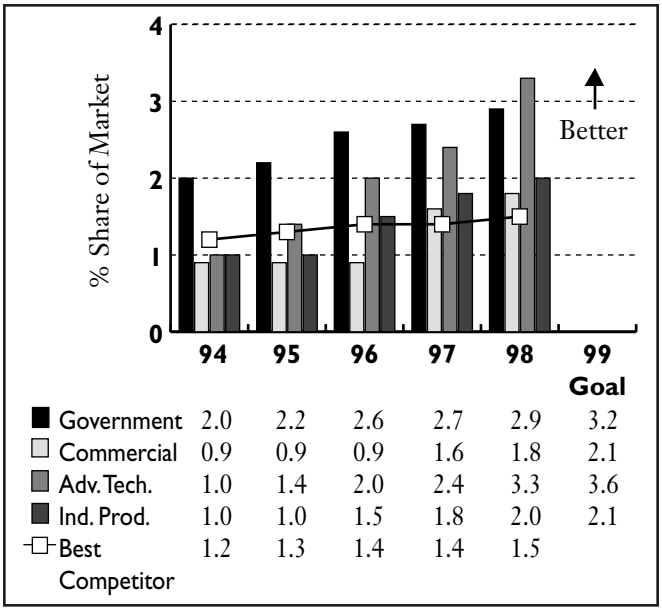

Figure 7.2-14 Overall Market Share

The breakdown of share by geographic region in Figure 7.2-15 reflects Collin's continued strong position in North America and Japan. Collin expects Europe to be a key contributor to future market share growth. It has increased marketing efforts and dedicated three international sales coordinators to the European market (Figure 7.2-17) to support its expansion in this region.

Collin defines customers as "new customers" in the year of their first purchase and as "repeat customers" if they place at least one order each year thereafter. As shown in Figure 7.2-16, Collin has substantially increased its customer base through its acquisition of new customers and achieved high levels of repeat business. (Collin has lost only six customers since 1994.) Collin's ability to

attract and retain customers has been a key factor in its substantial gains in revenue (Figures 7.2-2 and 7.2-3) and market share (Figures 7.2-14 and 7.2-15).

Accompanying Collin's expansion to a second manufacturing site, Collin has experienced substantial growth in its international sales coordinators worldwide (Figure 7.2-17). Strong growth in these positions is a positive indicator of long-term growth of the company. Following Collin's initiative to expand into global markets, Collin is also examining new locations for international sales coordinators and possibly a third manufacturing site in the European market.

	94	95	96	97	98
Government	2.2	2.3	2.6	2.8	2.9
Commercial	1.1	1.2	1.4	1.6	1.8
Adv. Tech.	2.5	2.6	2.9	3.1	3.3
Ind. Prod.	1.4	1.4	1.6	1.8	2.0
Europe	.3	.4	.9	1.2	1.4
Far East	3.4	3.5	2.6	3.9	4.0
North America	3.5	3.6	4.0	4.2	4.6
Total	7.2	7.5	8.5	9.3	10.0

Figure 7.2-15 Breakdown of Market Share by Segment and Region

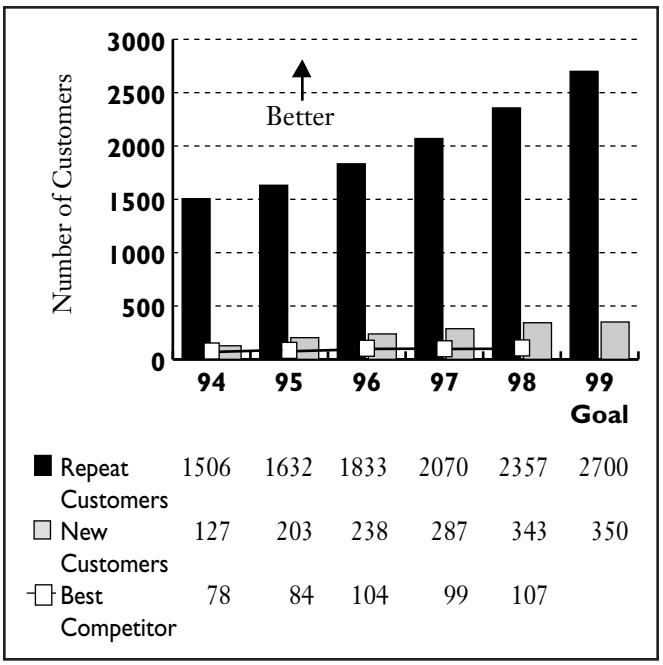

Figure 7.2-16 Increase in Customer Base

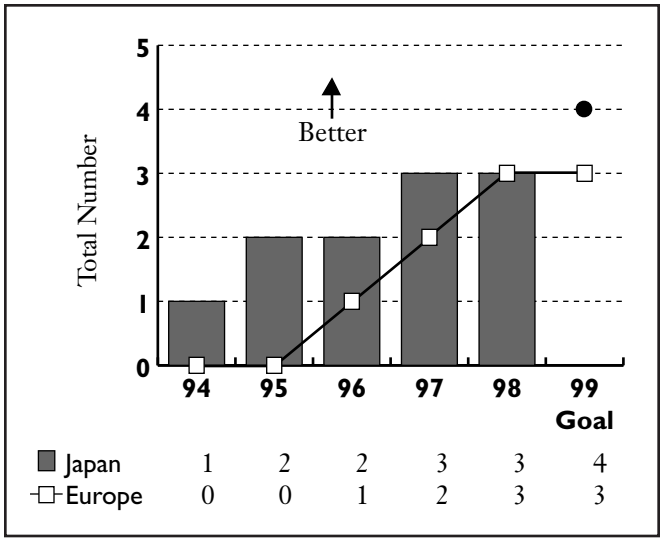

Figure 7.2-17 Expansion of International Sales Coordinators

7.3 Human Resource Results

Collin measures the effectiveness of the approaches it uses to build, maintain, and improve the work environment and support climate. Collin analyzes this through a combination of EO perceptions of the value of each element and objective measurement of effectiveness for specific activities that impact the work environment and climate. These data provide organization-level results. Space limitations do not permit Collin to present data for all the measures or to show all segmentation methods used to analyze the data.

Employee Satisfaction Survey results data for the three most important indicators of satisfaction at the Nashville location (Figure 7.3-1) and the Koga location (Figure 7.3-2) are provided on the next page. The importance of indicators is determined by having the respondents rate the importance of each attribute using a scale similar to the one used to rate satisfaction and dissatisfaction. This approach captures changes in importance and changes in satisfaction and dissatisfaction over time. It also permits extensive analysis of the interrelationships and changes of attributes over time.

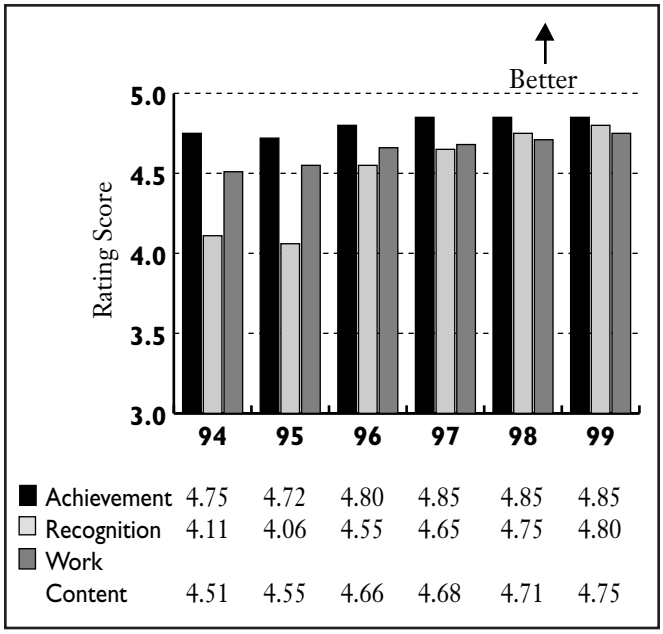

Figure 7.3-1 Overall EO Satisfaction (Nashville)

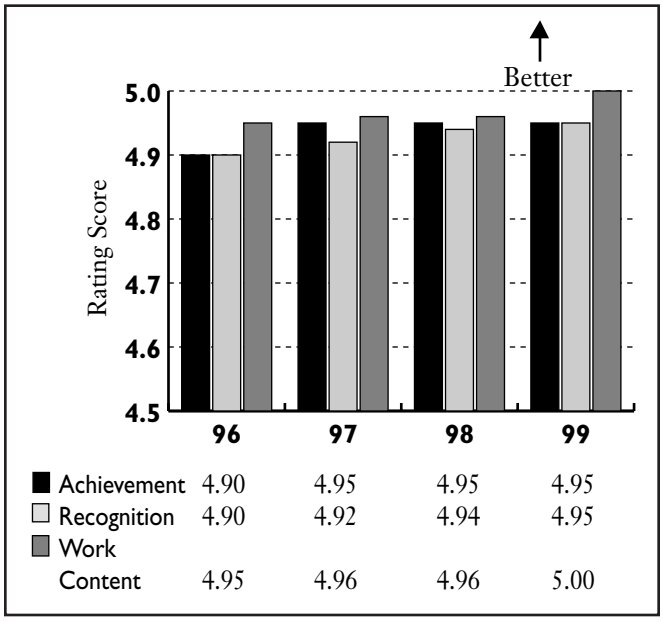

Figure 7.3-2 Overall EO Satisfaction (Koga)

Also, EOs use this survey to rate their satisfaction with major personal development opportunities (Figure 7.3-3). The ratings include end-of-course assessments and three- and six-month post-training assessments by EOs who completed training associated with that period (Area 5.2a).

Opportunities	94	95	96	97	98	99
Training	3.90	4.00	4.55	4.60	4.65	4.70
OTJ Experience	3.70	3.65	4.55	4.70	4.80	4.90
Team Member Coaching	4.32	4.33	4.84	4.83	4.82	4.90
Professional Associations	4.50	4.52	4.82	4.85	4.88	4.90
Management Coaching	4.88	4.89	4.96	4.92	4.91	4.91
Team Assignments	4.78	4.82	4.88	4.91	4.93	4.95
Self-Directed Learning	4.67	4.65	4.88	4.92	4.94	4.95
Special Projects	4.22	4.35	4.90	4.88	4.95	4.95
Overall Growth Opportunity	4.10	4.02	4.89	4.89	4.90	4.90

Figure 7.3-3 EO Satisfaction With Personal Development Opportunities

Figure 7.3-4 shows overall satisfaction with the main types of training programs as measured by the Employee Satisfaction Survey. Collin tracks these data by type of employee and other EO variables. The data are used to validate the results of the post-training assessments conducted three and six months after the training to identify the benefit the course brought to the job and its impact on actual job performance.

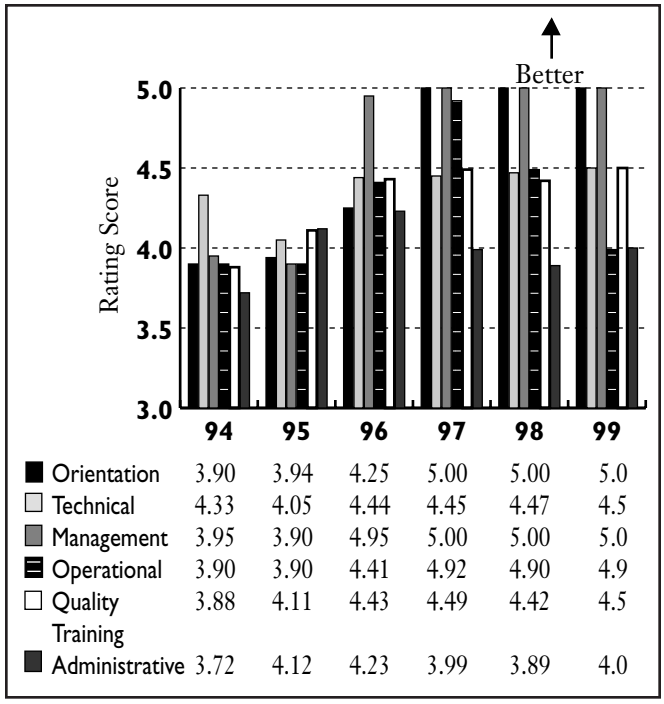

Figure 7.3-4 Satisfaction With Training

Collin uses the Employee Satisfaction Survey to measure EO satisfaction with services, benefits, and facilities. The survey uses a rating scale ranging from Very Satisfied ("5") to Very Dissatisfied ("1"). Figure 7.3-5 provides the support climate survey results for the major services, benefits, and facilities. Results are provided in order of the year the program was initiated.

Services, Benefits, Facilities	94	95	96	97	98	99
Cafeteria	3.27	3.22	4.01	4.18	4.25	4.30
Collin Park	3.90	3.62	4.85	4.89	4.89	4.90
ACE Activities – Nashville	4.04	4.02	3.98	4.89	4.89	4.90
Discount Tickets	4.04	4.02	3.98	4.89	4.89	4.90
Quarterly Outings	4.11	3.89	3.72	3.66	4.28	4.30
Clinic & Nurse	4.15	4.15	4.44	4.53	4.62	4.70
Health Promotion	4.75	4.82	4.85	4.88	4.89	4.90
Credit Union	4.77	4.77	4.74	4.78	4.79	4.80
EO Assistance	5.00	5.00	5.00	5.00	5.00	5.00
Tuition Assistance	5.00	5.00	5.00	5.00	5.00	5.00
ACE Activities – Koga	—	—	5.00	5.00	5.00	5.00
Travel Bureau	—	—	4.80	4.85	4.86	4.90
Family Enrich. – Nashville	—	—	4.89	4.95	5.00	5.00
Family Enrich. – Koga	—	—	4.80	4.85	4.86	4.90
Ethnic Lunches	—	—	—	4.82	4.83	4.90
Child Care	—	—	—	4.90	5.00	5.00
Wellness & Fitness Center	—	—	—	—	4.98	5.00
Preventive Wellness	—	—	—	—	4.98	5.00
Adoption Assistance	—	—	—	—	4.95	5.00
Winter Olympics	—	—	—	—	4.95	5.00

Figure 7.3-5 Satisfaction With Support Climate

These trends document the success of the improvements implemented over the last five years and underscore the accelerated rate of improvement since the Human Resource Council (HRC) assumed responsibility for support program selection.

The trend in higher satisfaction with the newer programs results from the HRC using prior survey data to improve the selection of programs. Current areas of focus are the Quarterly Outings and the Cafeteria. Preliminary research shows that company cafeterias are rated lower than other services in most companies. A focus group on the Quarterly Outings in 1997 identified staleness in format and time conflicts with family obligations as the causes of lower satisfaction. Changes in format in 1998 improved EO satisfaction with major health programs (e.g., Clinic & Nurse, Health Promotion, the Wellness & Fitness Center, and the Preventive Wellness Program).

Figure 7.3-6 shows the effectiveness of the EHS&S Program over the last five years. The Number of Hazards Observed is based on EHS&S Audits of compliance with proactive work activity standards (Area 5.3a) and current guidance from regulatory agencies. The Number of Hazards Unsolved is the key measurement the EHS&S Core Team uses to ensure that corrective, preventive action is taken in a timely manner. The other data are defined by regulatory agencies.

EHS&S Performance Measures	94	95	96	97	98	99	Ind. Avg.
# of Hazards Observed	56	42	31	30	26	25	
Unsolved Haz. > 30 days	2	3	2	1	1	0	
OSHA Report-able Injuries	0	1	0	0	0	0	5.46
Lost Work Days	0	0	0	0	0	0	22.6
Workers' Comp. Claims	0	0	0	0	0	0	2.14
Comp. & Ins. Cost/EO	255	281	303	318	335	350	

Figure 7.3-6 Effectiveness of EHS&S Program

Figure 7.3-7 shows team deployment by type, percentage participation by EOs, and the cumulative percentage of EOs completing certification for each level of team skills training (Figure 5.1-3).

Team Training Deployment	94	95	96	97	98	99
Total # Teams	36	38	40	49	67	95
# TQM	21	18	10	4	2	0
# PST	15	16	22	30	45	65
# IPDT	0	4	8	15	20	30
% EOs on Teams	100	100	100	100	100	100
% Cert. on Directing Skill	100	100	100	100	100	100
% Cert. on Coaching Skill	55	60	66	70	75	80
% Cert. on Support Skill	22	24	27	30	35	40

Figure 7.3-7 Team Deployment

Collin consistently outperforms the industry average in turnover (Figure 7.3-8). The slight increase in turnover in the last two years resulted from losing several highly skilled technical EOs to firms in other industries. The trend in performance to industry average is still positive. Turnover at Koga is zero due to the Japanese cultural expectation of lifetime employment and the impact of recent economic conditions that have enabled us to recruit highly motivated, well-trained workers. The Leadership Team views turnover as a key indicator of EO overall satisfaction and has added it to the BSC for review.

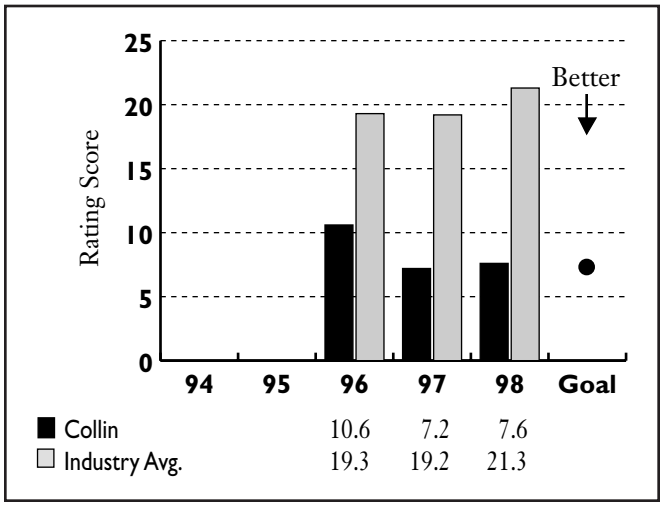

Figure 7.3-8 Turnover

Also, Collin tracks retention through tenure data. In 1998, 47% of EOs had over eight year's tenure, 32% had three to eight year's service, and 21% had less than three years.

Figure 7.3-9 shows aggregate data for both the number of suggestions per EO and the dollars awarded per EO over the last five years for each of the three main employee groups. This program recognizes and rewards suggestions by all types of EOs for process improvement or technological innovation. Suggestions by senior executives are not included in or compensated by the program. Compensation amounts are based on the proportion of the potential benefit assessed for the company. Collin tracks this data on a "per EO" basis to normalize the data for changes in employment. Suggestion data are presented by employee type to show the consistency of participation across the company. Suggestion data segmented by location, business unit, process, and job classification, and other variables show similar trends.

Figure 7.3-10 lists satisfaction with some of the various elements included in work and job design for the last five years. These data are derived from one or more questions on the Employee Satisfaction Survey.

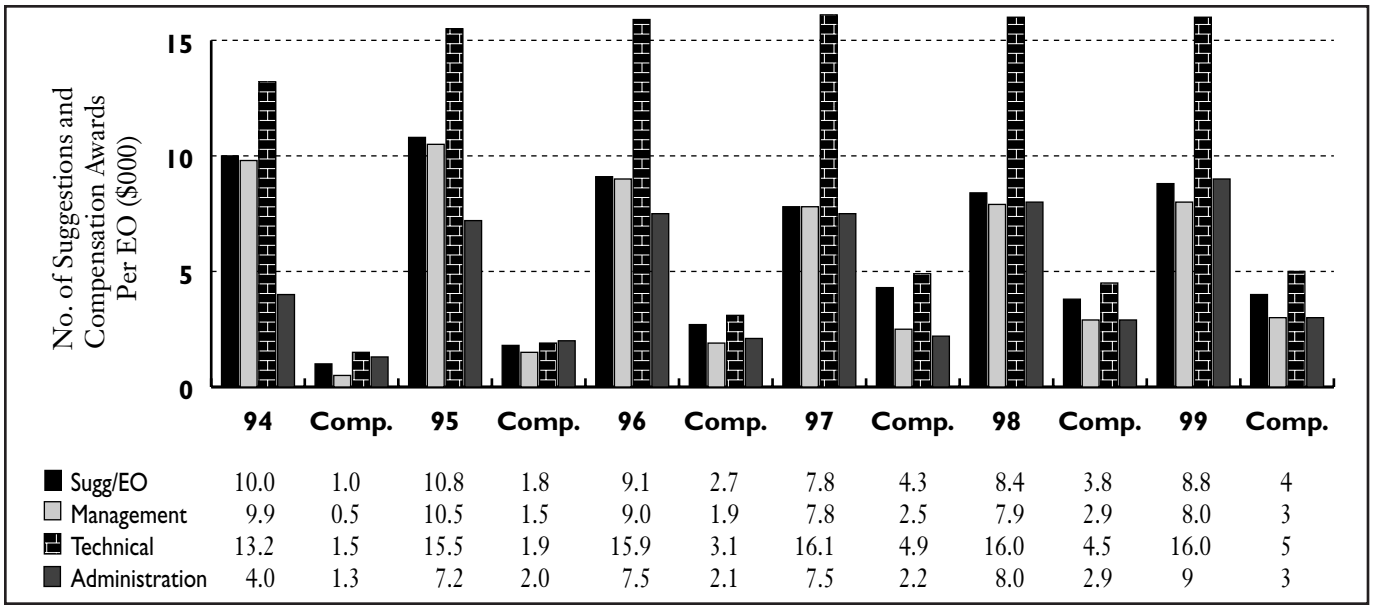

Figure 7.3-9 Suggestion Program

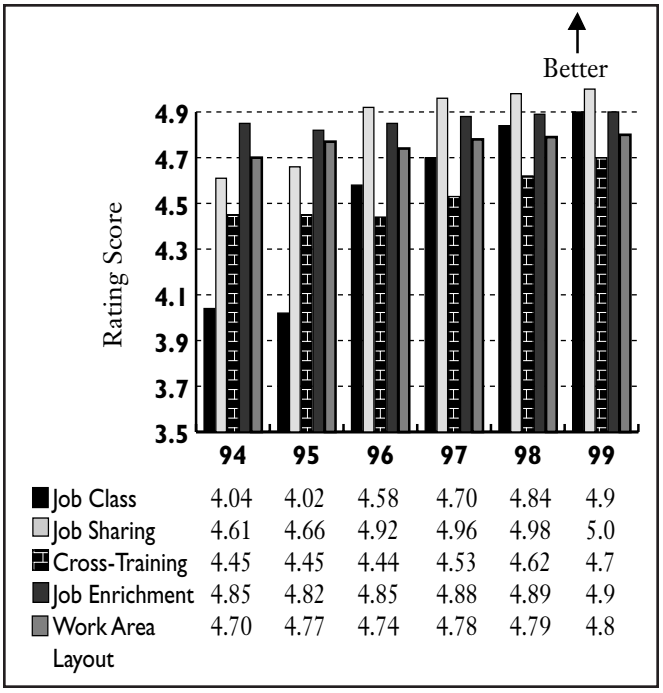

Figure 7.3-10 Satisfaction With Work & Job Design

7.4 Supplier and Partner Results

Collin depends on suppliers to provide high technology products of superior quality, on-time and at an ever reduced cost. The key performance requirements described in Item 6.3 are measured and reviewed continually for both suppliers of product materials as well as suppliers of support materials and services. Collin uses the number of problems experienced with suppliers as an indicator of quality. Figure 7.4-1 shows the supplier quality levels for product material. Results for suppliers of support materials and services, which are measured in the same manner, are shown in Figure 7.4-2.

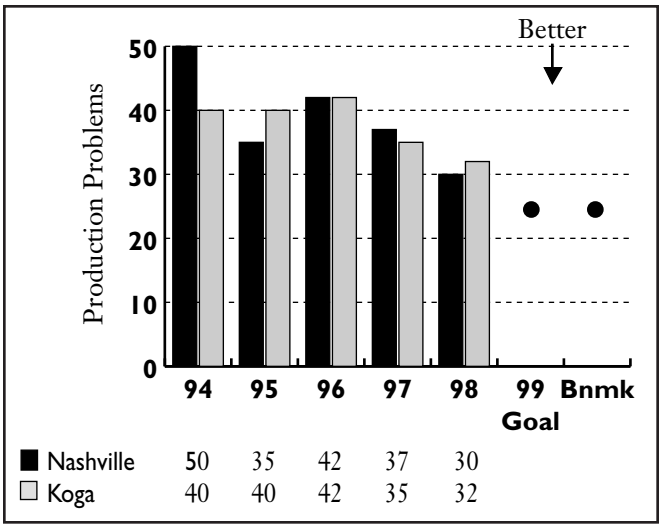

Figure 7.4-1 Supplier Quality (Product Material)

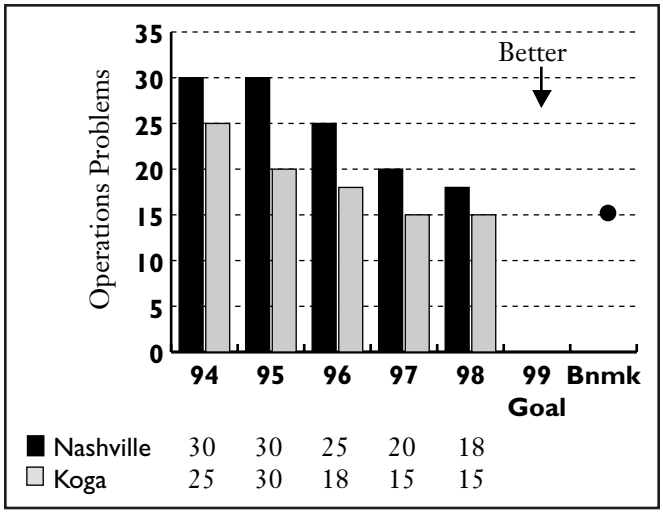

Figure 7.4-2 Supplier Quality (Support Materials and Services)

On-time delivery is the second key performance requirement for Collin suppliers. Figures 7.4-3 and 7.4-4 show the percent of material delivered on the agreed upon delivery date for each category of supplier.

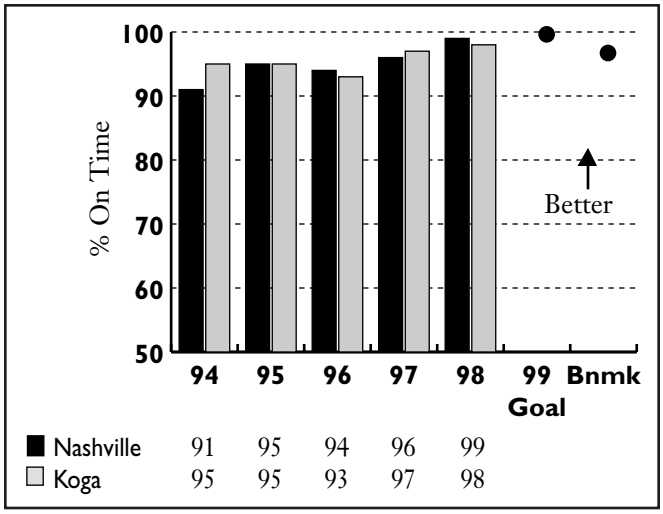

Figure 7.4-3 On-Time Delivery (Product Materials)

A key goal of the company is to continually reduce the cost of products delivered to customers. To attain this goal, it is a requirement for suppliers to continually reduce the cost of the materials and services they furnish. Goals for each supplier are established each year, and progress toward those goals is tracked for both the material going into products as well as materials and services used in the support areas. Figures 7.4-5 and 7.4-6 show cost trends for both product materials and support materials. The material cost reductions by the suppliers aid in the ongoing cost reductions of the final products for customers. This ongoing accomplishment is shown in Figure 7.5-2.

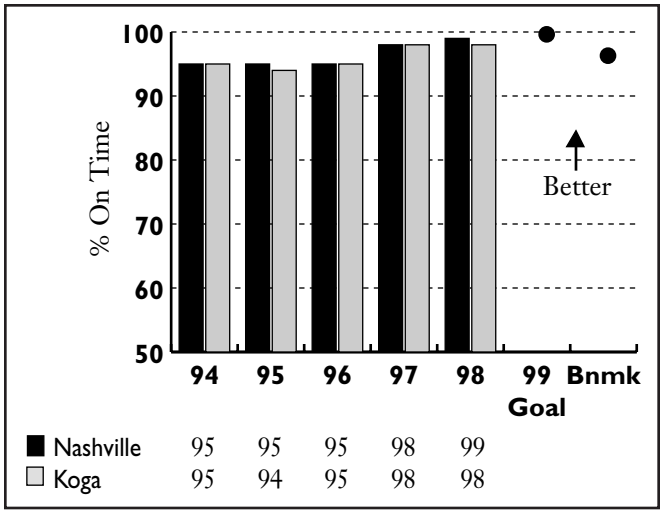

Figure 7.4-4 On-Time Delivery (Support Material and Services)

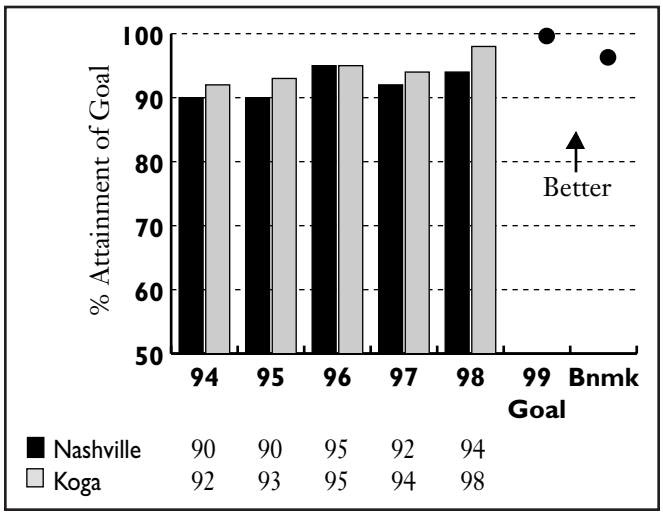

Figure 7.4-5 Material Cost (Product Material)

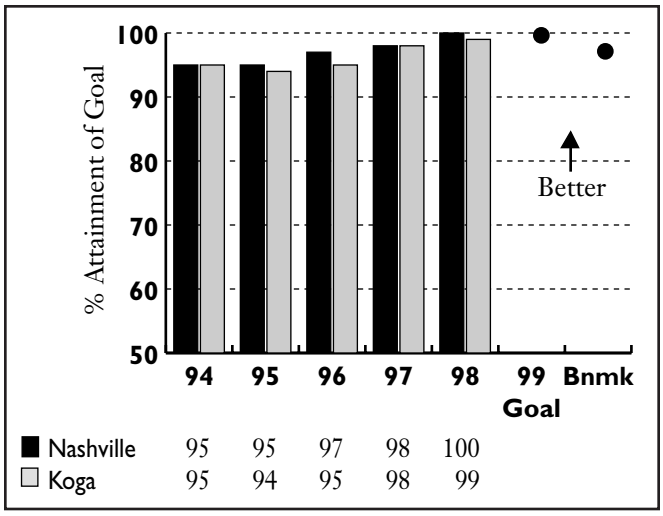

Figure 7.4-6 Material Cost (Support Material and Services)

Collin utilizes five areas to rate and measure all suppliers and to determine the status of preferred suppliers. At the present time, Collin has designated 48 of its 96 suppliers of both product materials and support material and services as preferred suppliers. To attain preferred supplier status, the supplier must score above 95% overall and at least 90% in each of the five areas described in Area 6.3a. Figure 7.4-7 shows the growth in the number of preferred suppliers at both locations.

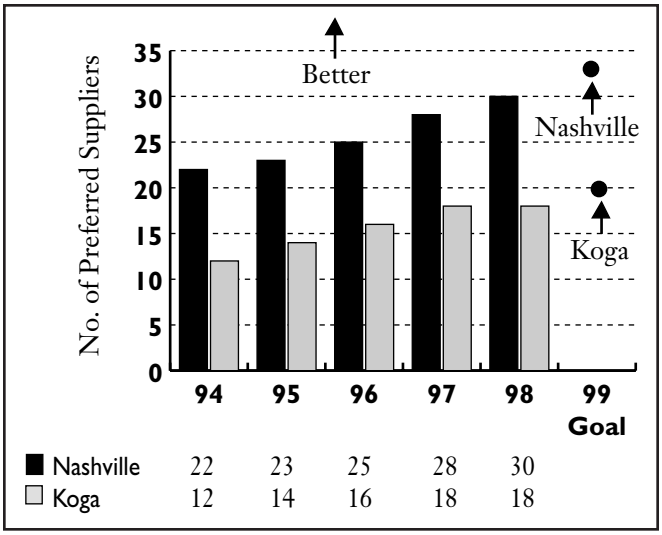

Figure 7.4-7 Preferred Suppliers (Growth)

The results in Figure 7.4-8 show the rating accomplishments of the current 48 preferred suppliers, and Figure 7.4-9 demonstrates supplier ratings for Collin's suppliers who are still aspiring to become preferred suppliers. Because of the lower dollar value associated with these relationships, this metric is monitored at the work site levels.

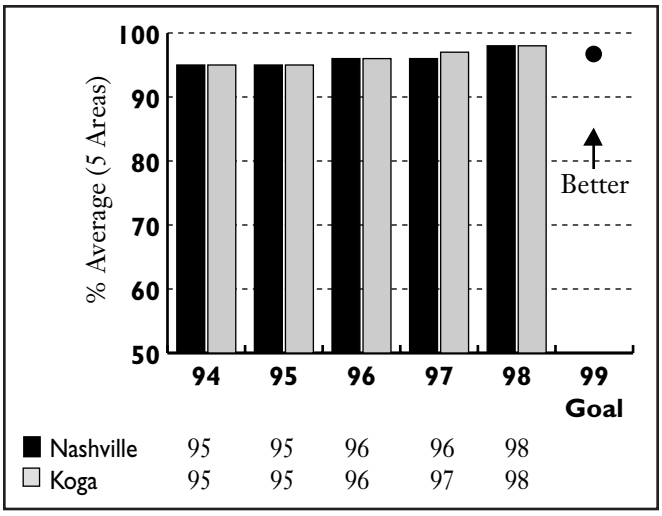

Figure 7.4-8 Supplier Rating (Preferred Suppliers)

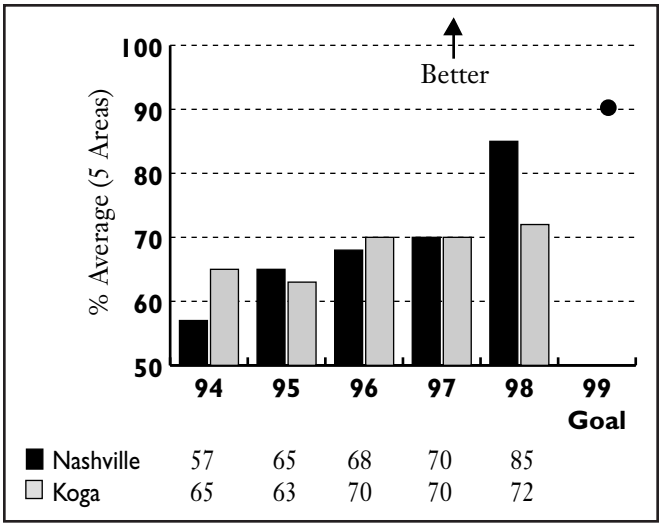

Figure 7.4-9 Supplier Rating (Not Yet Preferred Suppliers)

To provide business assistance to suppliers and to help them become more effective and more successful in the marketplace, Collin furnishes training activities important to the various suppliers. Figure 7.4-10 shows the percent of suppliers that have taken advantage of training opportunities when offered. Suppliers continue to provide the necessary materials and skills to make Collin a successful organization. Suppliers continue to bring advanced technology applications to all phases of the operation. Although Collin has not met all goals and benchmarks in the supplier area, significant accomplishments have been attained. The supplier area remains an area of potential improvement in the future.

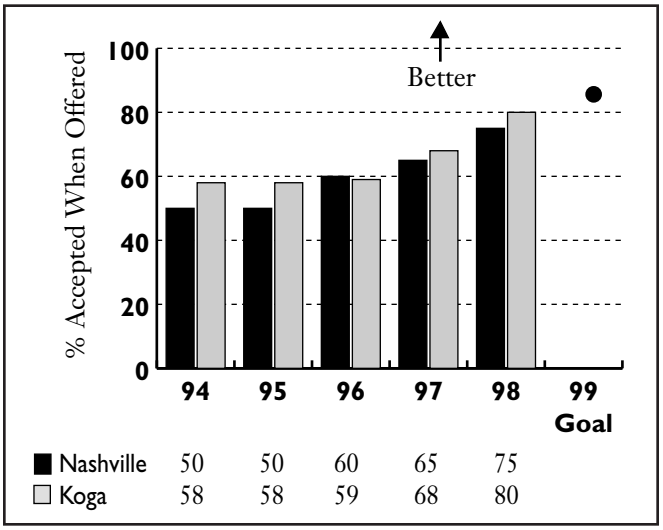

Figure 7.4-10 Suppliers Utilizing Training Opportunities

7.5 Organizational Effectiveness Results

7.5a Since on-time delivery is essential for the customer, Collin has established a goal of reducing cycle time in its production and support processes by 5% a year. Figure 7.5-1 shows the cumulative improvement in cycle time since 1994 as well as the yearly data for each location. The 5% reduction goal was attained at both locations in 1998.

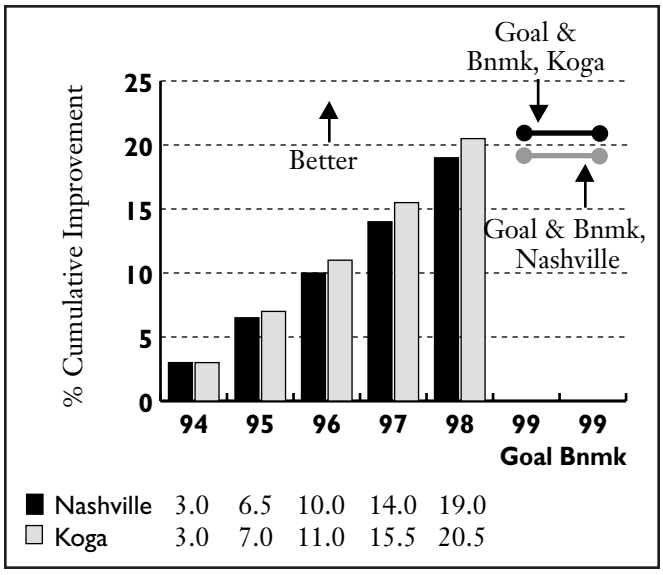

Figure 7.5-1 Cycle Time Improvement

Along with quality and on-time delivery, a third key element in delivering the highest value to customers is that of price. The company has set a stretch goal to reduce production costs 2% each year to provide Marketing and Sales the flexibility to pass on price reductions whenever possible. Figure 7.5-2 shows the percent cumulative improvement since 1994. The data for each year show improvement in both Nashville and Koga, with both locations reaching the goal of 2% improvement in 1998.

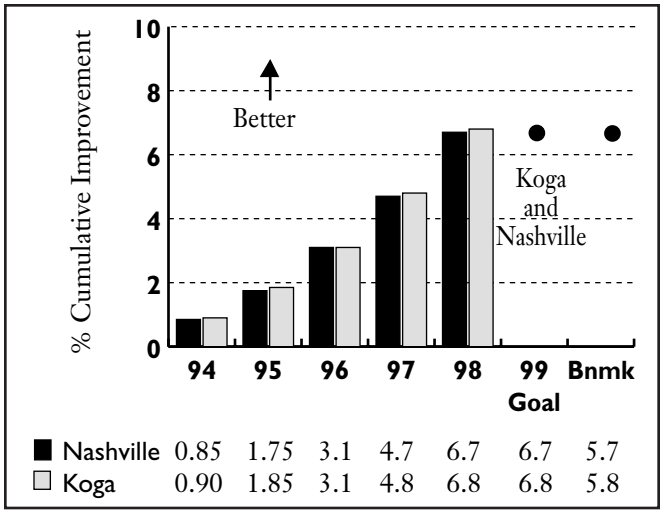

Figure 7.5-2 Improvement in Production Cost

The basis for integrating all company activities together is the CAIN system described in Category 4. The importance of this key support process is very high, and significant resources have been allotted to the activity. The effectiveness of CAIN is measured in several ways. The availability of the system when it is needed and its responsiveness (how long an operator is required to wait to access the desired information) are plotted in Figure 7.5-3. The goal of 99.9% availability has been attained in 1998, and the response time goal has been exceeded. There is no distinction between locations as there is a single worldwide CAIN system.

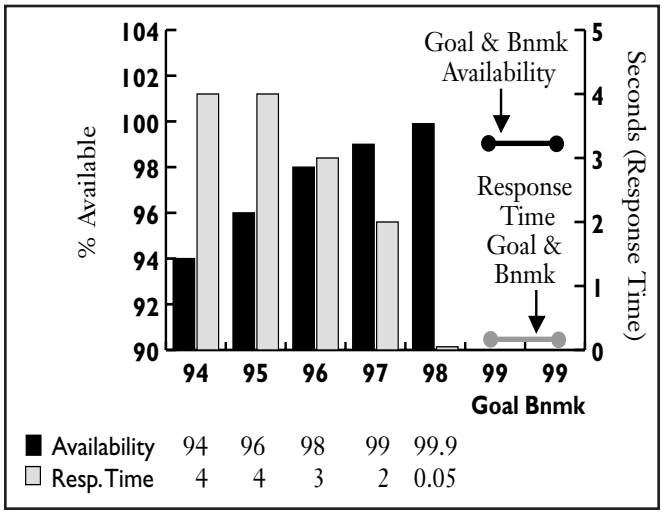

Figure 7.5-3 CAIN Operational Effectiveness

Safety is a top priority at Collin, and Collin is recognized by businesses worldwide as a role model in safety. Besides monitoring EOs at work, Collin also monitors its suppliers who work with hazardous materials. The results show the emphasis placed on safety by the management and the EOs. Figure 7.5-4 shows all reportable accidents at both Nashville and Koga. Although Nashville has not reached the goal of only 1 incident per month, it is

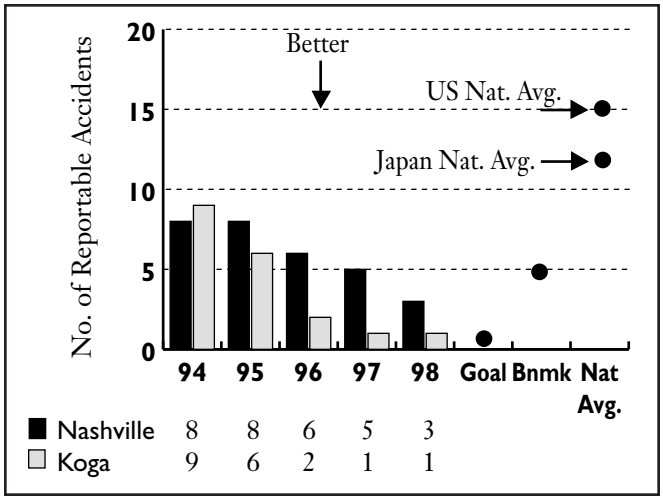

Figure 7.5-4 Accident Incidents

significantly better than the benchmark of 5 and the national averages of 15 and 12.

A key support function identified in Item 6.2 is the maintenance of equipment and facilities. With the completely automatic process, there is no time for down time of the system. Since the company operates 24 hours a day, seven days a week, the maintenance process has been constructed with parallel processing steps to be utilized without taking the complete system down.

Figure 7.5-5 shows the percent of time the total system is up. The goal is 100%, although no other facility reaching 100% has been located anywhere in the world. The best found to date is 95% in Japan, and the best in the industry in the United States is 85%. Collin exceeds the benchmark of 95% in both locations.

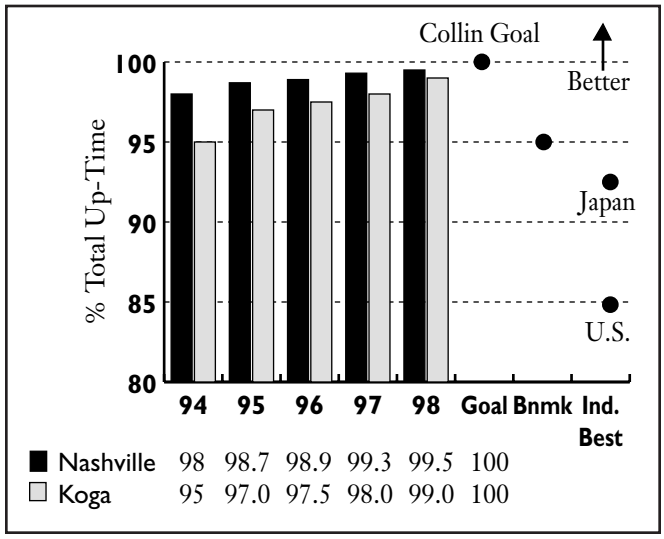

Figure 7.5-5 Production Equipment Up-Time

As described in Area 1.2a, Collin accomplishes energy conservation and measures the accomplishment with an Energy Dead Time Indicator. Figure 7.5-6 shows the cumulative results since 1994. No comparisons are available as a comparable process has not been found in any other organization.

Collin tracks production progress during the month as described in Area 4.2a to assure production schedules and customer on-time deliveries. Figure 7.5-7 shows Collin's ability to plan and execute to a planned schedule for the last five years. Trigger limits are below the stretch goal in Nashville and are at the total goal of 8. No comparisons are provided as no comparable process has been determined in the multilayer board industry.

Results for the EHS&S Audit described in Area 5.3a are displayed in Figure 7.5-8. This is a specific company audit, and no comparisons are available.

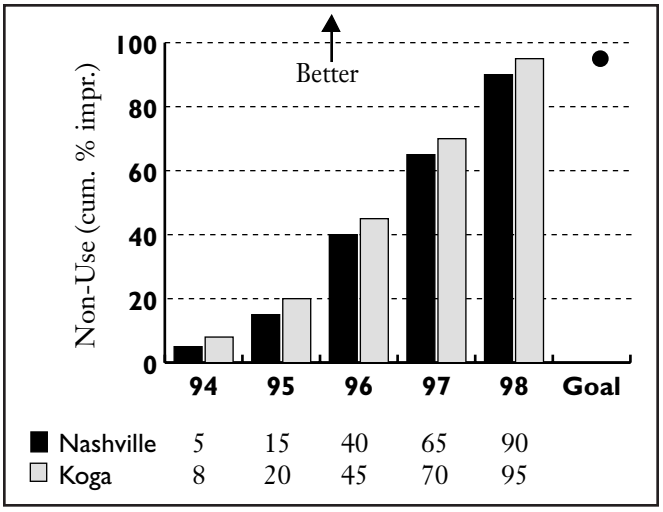

Figure 7.5-6 Energy Dead Time

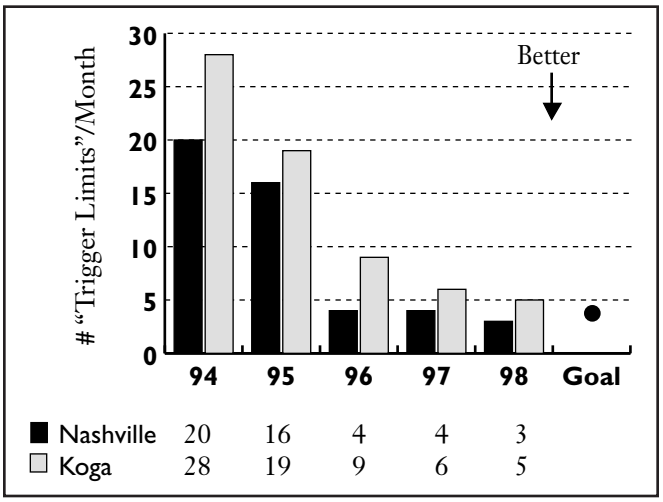

Figure 7.5-7 Planned Schedule Execution (Linearity Deviation)

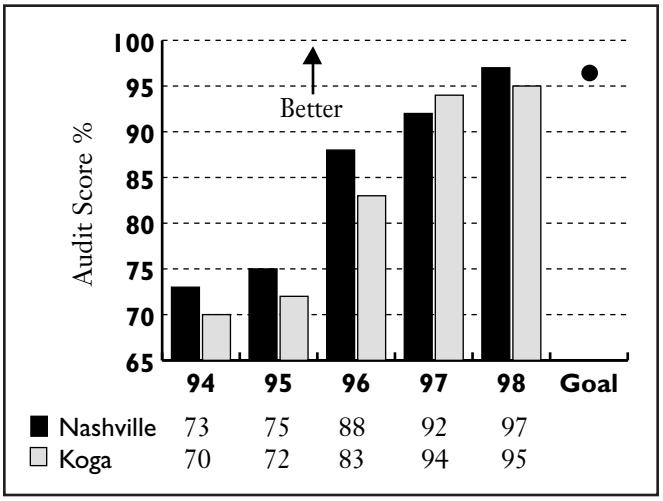

Figure 7.5-8 EHS&S Audit

To assure that all processes maintain the designed Cpk's, processes are sampled continuously as described in Area 6.1b to ensure that they remain in control and mean values are maintained. An example of these results is shown in Figure 7.5-9.

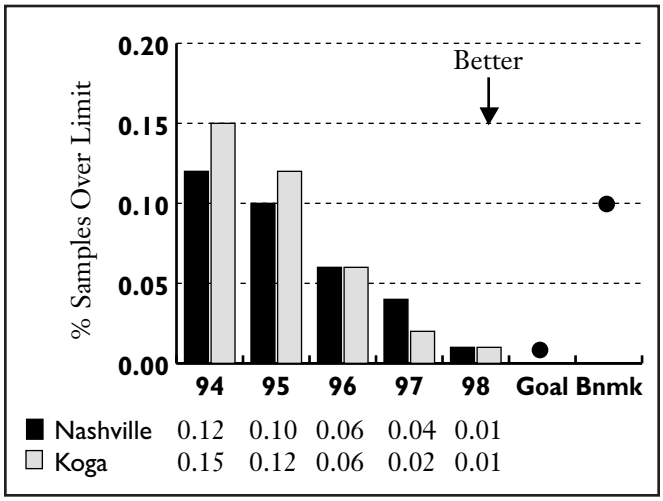

Figure 7.5-9 In-Process Sampling Audit (Thickness of Laminated Bds.)

In order for Collin to capture and maintain a leadership position in the competitive, high technology multilayer printed circuit board industry, it must be able to improve prices through productivity improvement and decrease product development cycle time. The company must also be able to react quickly to new and changing technical requirements from an increasing number of customers. Collin tracks its progress on these two competitive issues as shown in Figures 7.5-10 and 7.5-11.

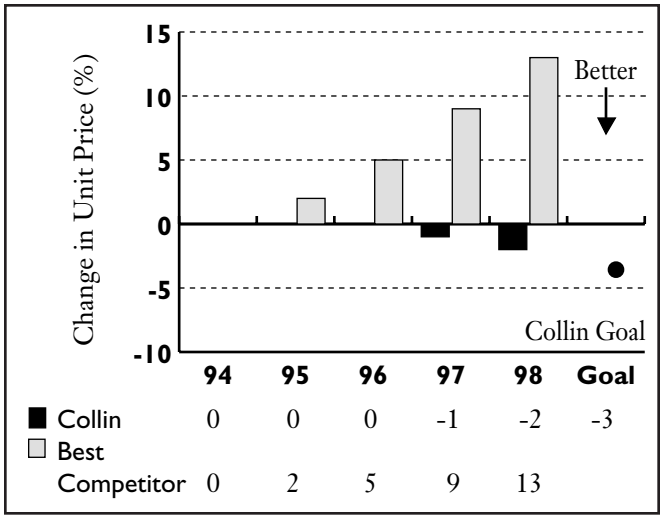

Figure 7.5-10 Unit Price Improvement

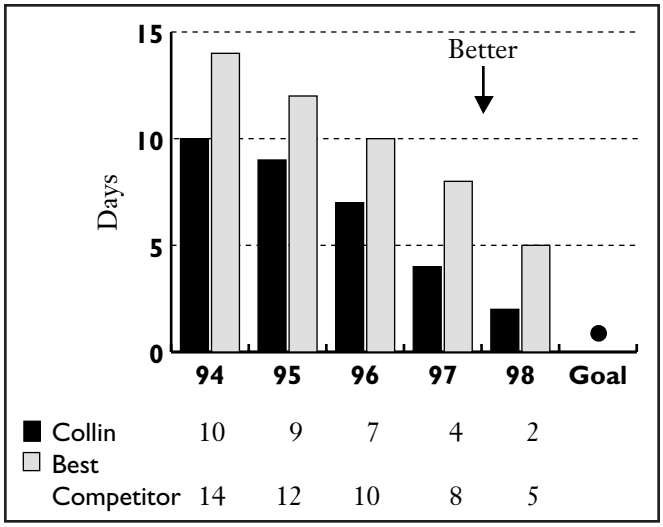

Figure 7.5-11 Product Development Cycle Time

In conjunction with its approaches for process design and control (Items 6.1 and 6.2), Collin has established a goal to have all production and support processes achieve a minimum Cpk of 2.0. Progress toward this goal is shown in Figure 7.5-12. No other company is known to have established a comparable goal.

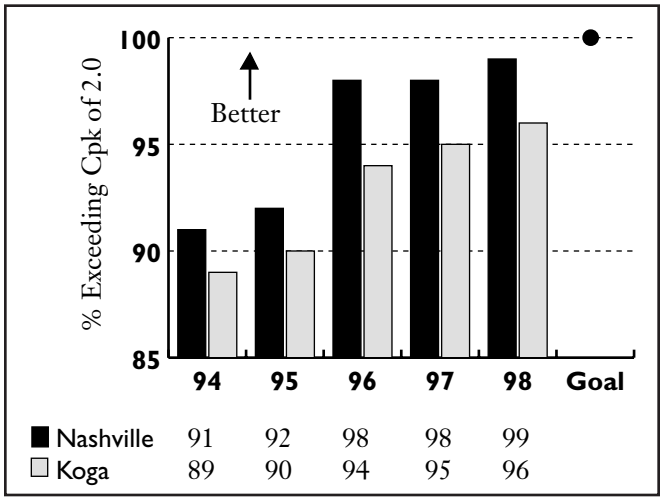

Figure 7.5-12 % Processes with Cpk > 2.0

Collin considers its environmental responsibilities, air and water emissions and handling of waste materials, as key measures of legal compliance and good citizenship. Some outstanding results have been achieved, yet challenges still exist. Corrective actions are already being taken to resolve any open issues.

Many aspects of environmental protection are measured, and four results are shown here. Figure 7.5-13 shows the emissions to the atmosphere. Both facilities have met the stretch goal of 0.1 Tons of Total Contaminants per year and are significantly below the respective national requirements in both countries.

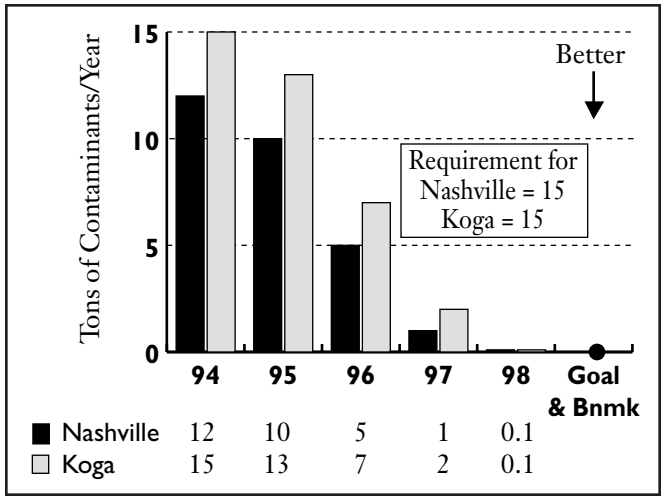

Figure 7.5-13 Emissions to the Atmosphere

The State of Tennessee has recognized the company as a "model system" in the emission control area. The company has received multiple awards from several magazines including *Industry Magazine* and *Printed Circuits Today.*

A second environmental indicator is Contaminants in Waste Water (Figure 7.5-14). A reverse osmosis system recently installed at both locations is expected to meet the company goals. A water purification system installed in 1997 did not perform as the supplier had guaranteed. Although the company received its money back, meeting the goals has been delayed.

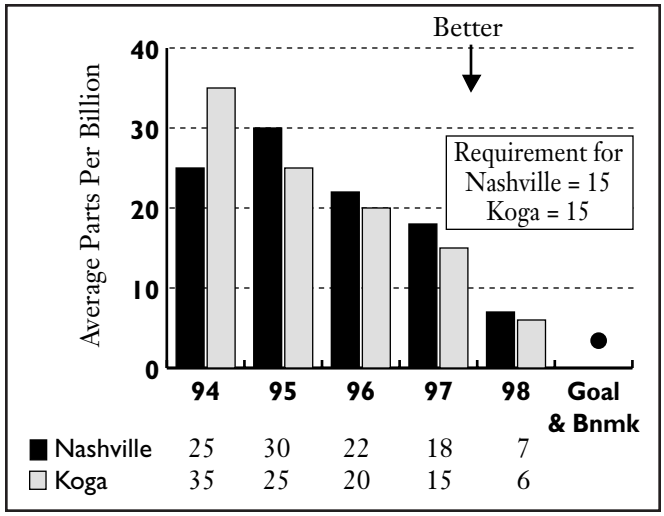

Figure 7.5-14 Contaminants in Waste Water

Collin has pursued the reclaiming of materials by collaborating with suppliers because they have more knowledge concerning how materials can best be effectively recycled. In many cases, suppliers are able to help Collin refine the chemicals and return them to near pure form. By selling or using reclaimed

materials, Collin offsets some of the cost for their removal from its waste streams. Figure 7.5-15 shows Collin's progress toward reclaiming materials from its waste streams.

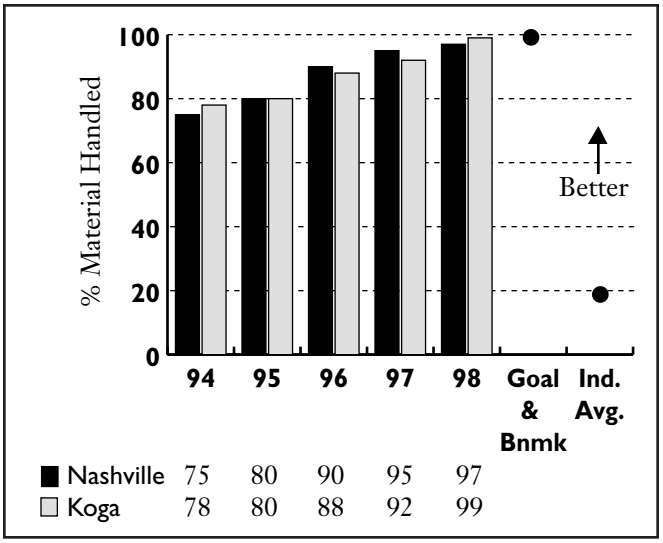

Figure 7.5-15 Reclaimed Material

Figure 7.5-16 shows that the goal of not sending any manufacturing material to a landfill has been attained. Much of this success is the result of the material reclaiming process discussed above.

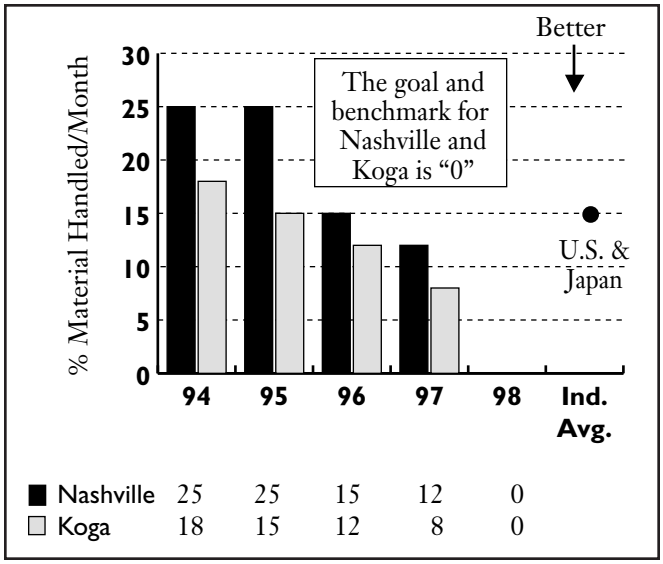

Figure 7.5-16 Manufacturing Solid Waste to Landfill

Collin is a very successful company with a bright future. The company has received many awards from its customers and other stakeholders, including the State Quality Award. It has also received the top supplier award from 20 major customers. Collin has been recognized for its safety program locally, in the State, and nationally in both Japan and the United States. The company has not received any sanctions or notices of non-compliance for any environmental characteristic from either the Nashville or Koga locations.

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